

DEPARTMENT OF ECONOMICS

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MASTER'S THESIS

The impact of household leverage on
mortgage foreclosures in Norway:
A threat to stability?

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Submitted: May 2013

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Master's Thesis at the Department of Economics

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Summary

From 2006 to 2011, the number of filed foreclosures per annum in Norway has risen by 60 percent at the national level, and in some counties the increase has been more than 150 percent. Over the same period, both the unemployment rate and interest rates have been notably low. A bank files to foreclose a house when the debtor fails to meet his periodic mortgage installments. Hence, the increase in filed foreclosures suggests that an increasing number of households are unwilling or unable to maintain their debt burden. So far, the recent increase in filed foreclosures has not been realized in an equal increase in the number of actual foreclosures. However, the rising gap between filed and actual foreclosures may suggest that pending losses are building up in the household sector.

This thesis seeks to understand the trends in filed and actual foreclosures and its links to the development in household debt and housing prices. A main objective is to assess whether the recent trends in filed foreclosures reflect an increased debt vulnerability among Norwegian households. Furthermore, I ask whether there are factors that could turn such vulnerability into realized losses.

In order to approach these questions, I proceed in two main steps. First, a theoretical model for foreclosures fitted to the Norwegian institutional setup is developed in order to shed light on possible causes of the recent developments. Second, the hypothesis of this model is tested empirically by using a newly gathered regional data set on filed and actual foreclosures. The data set allows me to assess the importance of several explanatory variables that are not included in other work on foreclosures in Norway. Moreover, by exploiting the panel structure in the data, more statistically robust results can be obtained.

Evidence from the estimated model suggests that the growth in household debt has been the main factor contributing to the rapid increase in filed foreclosures the last 5 years. I find strong evidence for the existence of a cointegrating relationship between filed foreclosures, household debt and unemployment, where a one percent increase in household debt leads to a 1.5 percent increase in the number of filed foreclosures in the long run.

That said, I find that the development in housing prices has kept the number of actual foreclosures down. As housing prices increase, the debtors' collateral value increases as well. Consequently, the bank may be more willing to refinance the mortgage rather than

foreclosing the house. This, I argue, is because the bank through a refinancing deal can earn more due to an expected increase in the housing value. The estimation shows that between 35 and 50 percent of the filed foreclosures could end up in an actual foreclosure in the absence of any refinancing. However, an increase in housing prices significantly lowers the fraction of filed foreclosures realized as actual foreclosures.¹

These results point to a fragile situation for a substantial number of Norwegian households. For the households experiencing a filed foreclosure, the sustainability of their debt burden seems to depend crucially on expectations of growing housing prices. If the unemployment rate increases, or housing price expectations fall, a larger number of the filed foreclosures could be realized, causing an increase in actual foreclosures with subsequent losses for creditors and debtors.

The thesis proceeds in eight sections. After the introduction and a brief background description, a literature review is presented in Section 3. In Section 4 a description of the legal framework of foreclosures in Norway is provided. In Section 5, I present a theoretical model for filed and actual foreclosures. The data and methodology used in this thesis is described in Section 6, before the results are presented in Section 7. Section 8 concludes.

¹All calculations and tests in this thesis are calculated using the software package STATA.

Preface

This thesis was written during my internship in the Research Department at Norges Bank (the Central Bank of Norway). I would like to express my gratitude to Norges Bank for providing me with economic funding and inspiring working conditions.

Several individuals have contributed to this thesis. In particular, I want to thank Farooq Akram at Norges Bank for believing in this project and for giving me the necessary time to investigate the topic. Furthermore I want to thank Marius Jurgilas, Artashes Karapetyan, Kjersti-Gro Lindquist and Vegard Nygård in Norges Bank for valuable comments and discussion. Vegard Nygård also contributed with motivating coffee breaks and occasional beers. The data set was gathered by generous help from Steinar Weseth in Oslo Byfogdembete and the Norwegian Court Administration. Moreover, I want to thank Egil Rokhaug for important information on the Norwegian foreclosures procedure.

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And finally, I want to express my sincere gratitude to the most important contributor, my supervisor André Anundsen. His insight and enthusiasm have been indispensable. All remaining errors are of course my and only my responsibility.

Abstract

Over the period 2006-2011, the number of filed foreclosures among Norwegian households has risen by 60 percent at the national level. In some counties, the number of filed foreclosures has increased with more than 150 percent. Based on a theoretical model for the determinants of foreclosures, this thesis empirically investigates what are the main drivers of filed and actual foreclosures. My results, making use of a newly gathered panel data set covering all 19 counties over the past 15 years, suggest that the growth in household debt have been the main factor behind the rapid increase in filed foreclosures the last 5 years. However, the results also indicates that the rise in housing prices have stopped this increase in filed foreclosure from being fully materialized as actual foreclosures.

The increase in the number of filed foreclosure may suggests that losses are building up in the household sector. If unemployment or interest rates were to increase or, even more importantly, housing price expectations fall, a larger number of the filed foreclosures could easily be realized, causing a larger number of houses to be foreclosed with subsequent losses for creditors and debtors.

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1 Introduction

From 2006 to 2011, the number of filed foreclosures in Norway has risen by 60 percent at the national level, and in some counties the increase has been more than 150 percent. Over the same period, both the unemployment rate and interest rates have been notably low.² Thus, given the favorable macro-economic situation, the increase in filed foreclosures seem surprising.

A bank files to foreclose a house when the debtor fails to meet his periodic mortgage installments. Hence, the increase in filed foreclosures suggests that an increasing number of households are unwilling or unable to maintain their debt burden. So far, the recent increase in filed foreclosures has not been realized in an equal increase in the number of actual foreclosures. However, the rising gap between filed and actual foreclosures may suggest that pending losses are building up in the household sector.³

This thesis seeks to understand the trends in filed and actual foreclosures and its links to the development in household debt and housing prices. A main objective is to assess whether the recent trends in filed foreclosures reflect an increased debt vulnerability among Norwegian households. Furthermore, I ask whether there are factors that could turn such vulnerability into realized losses.

A large literature on the determinants and consequences of developments in foreclosures exists for a number of countries. The literature has established the importance of several macroeconomic factors, such as unemployment, income, debt and housing prices in explaining foreclosures.⁴ Moreover, evidence has been provided showing the adverse impacts of foreclosures on the real economy (Mian, Sufi and Trebbi, 2011). However, the existing literature on foreclosures in Norway is scarce. Astrup and Holm (2009) is the only paper that explicitly investigates the developments in foreclosures. Their paper provides important knowledge about the characteristics of the persons experiencing a foreclosure, yet their analysis of the impact of the macroeconomic development is somewhat limited due to the lack of sufficient data.

Although little work has been done on analyzing the causes of foreclosures in Norway,

²Over the period 2006-2011, the unemployment rate has been at 2.5 percent on average and the nominal interest rate has averaged at 3 percent. Source: Statistics Norway.

³The number of actual foreclosures has increased by 34 percent from 2006-2011 while filed foreclosures has increased by about 60 percent.

⁴See Aron and Muellbauer (2010) and Foote et al (2009) for a brief survey of the literature.

related work on households' debt-servicing capacity exists.⁵ In a recent paper, Lindquist (2011) investigates the sustainability of the current debt level among Norwegian households and finds that some age-segments may be unable to sustain their debt when interest rates return to a more "normal" level.⁶ I argue that the recent trends in the foreclosure data provide an appealing supplement in the assessment of such debt vulnerability. By looking at the number of household that already fail to pay their debt installments, the impact of households' debt vulnerability can be evaluated based on the agents observed behavior.

This thesis expands the analysis of Astrup and Holm by developing an explicit theoretical model of foreclosures for the Norwegian institutional setup. Second, the hypotheses of this model is tested empirically by using a newly gathered regional data set on filed and actual foreclosures. The data set allows me to asses the importance of several explanatory variables that are not included in the analysis of Astrup and Holm, and by exploiting the panel structure in the data, more statistically robust results can be obtained.

Based on the estimated model, I find evidence suggesting that the growth in household debt has been the main factor contributing to the rapid increase in filed foreclosures the last 5 years. I find strong evidence for the existence of a cointegrating relationship between filed foreclosures, household debt and unemployment, where a one percent increase in household debt leads to a 1.5 percent increase in the number of filed foreclosures in the long run.

However, the development in housing prices seems to have kept the number of actual foreclosures down. As housing prices rise, the debtors' collateral value increases. Consequently, the bank may be more willing to refinance the mortgage rather than foreclose. This, I argue, is because the bank through a refinancing deal can earn more due to an expected increase in the housing value. The estimation shows that between 35 and 50 percent of the filed foreclosures could end up in an actual foreclosure in the absence of any refinancing. However, an increase in housing prices significantly lowers the fraction of filed foreclosures realized as actual foreclosures.

These results points to a fragile situation for a substantial number of Norwegian households. For the households experiencing a filed foreclosure, the sustainability of

⁵See for instance Poppe (2005), Vatne (2008) and Guldbrandsen (1999).

⁶Which seems lik a probable scenario given the interest rate projections in Norges Bank (2013).

their debt burden seems to depend crucially on expectations of growing housing prices. If the unemployment rate increases, or housing price expectations fall, a larger number of the filed foreclosures could be realized, causing an increase in actual foreclosures with subsequent losses for creditors and debtors.

The scope of this thesis is to investigate the impact of a broad set of macroeconomic variables on foreclosures. Consequently, the individual characteristics of those experiencing a filed or an actual foreclosure is not considered in any depth. This has some important drawbacks. First, the individuals that experience filed and actual foreclosures differ in many respects, especially on their exposure to the business segment. Thus the aggregate effect estimated in this thesis may hide important variation within the group of those experiencing a filed or an actual foreclosure. Second, this group may to some degree differ from the rest of the population. Consequently, it can be problematic to infer to what extent different factors may lead to an increase in foreclosures at a more disaggregate level.

The thesis proceeds in eight sections. After a brief background description, a literature review is presented in Section 3. In Section 4 a description of the legal framework of foreclosures in Norway is provided. In Section 5, I present a theoretical model for filed and actual foreclosures. The data and methodology used in this thesis is described in Section 6, before the results are presented in Section 7. Section 8 concludes. ⁷

2 Background

During the last decade, the debt-to-income ratio of Norwegian households has increased substantially, growing from 133 percent in 2000 to about 200 percent in 2010. At the same time, there has been a tremendous increase in housing prices with real housing prices increasing by 50 percent in the period 2000-2010.⁸ This development has led the Financial Supervisory Authority (FSA) in Norway and Norges Bank to warn against the financial vulnerability that arises from a highly leveraged household sector.⁹ In particular, FSA

⁷All calculations and tests in this thesis are calculated using the software package STATA.

⁸Statistics Norway Table 09477 and 07230.

www.ssb.no/statistikkbanken/selecttable/hovedtabellHjem.asp?KortNavnWeb=bpi

[//www.ssb.no/statistikkbanken/selecttable/hovedtabellHjem.asp?KortNavnWeb=finsek](http://www.ssb.no/statistikkbanken/selecttable/hovedtabellHjem.asp?KortNavnWeb=finsek)

⁹See Finanstilsynet (2012) and Norges Bank (2012).

notes that the debt has increased most among young and low-income groups, making these households particularly vulnerable to negative shocks. Moreover, previous experiences in Norway and other countries suggest that the repercussions are great if households have to tighten consumption significantly. Large parts of the business sector will be affected, unemployment will increase and banks will have higher loan losses, particularly on loans to small businesses (FSA 2012).

Figure 1: The number of filed (right axis) and actual foreclosures (left axis) 1980- 2011

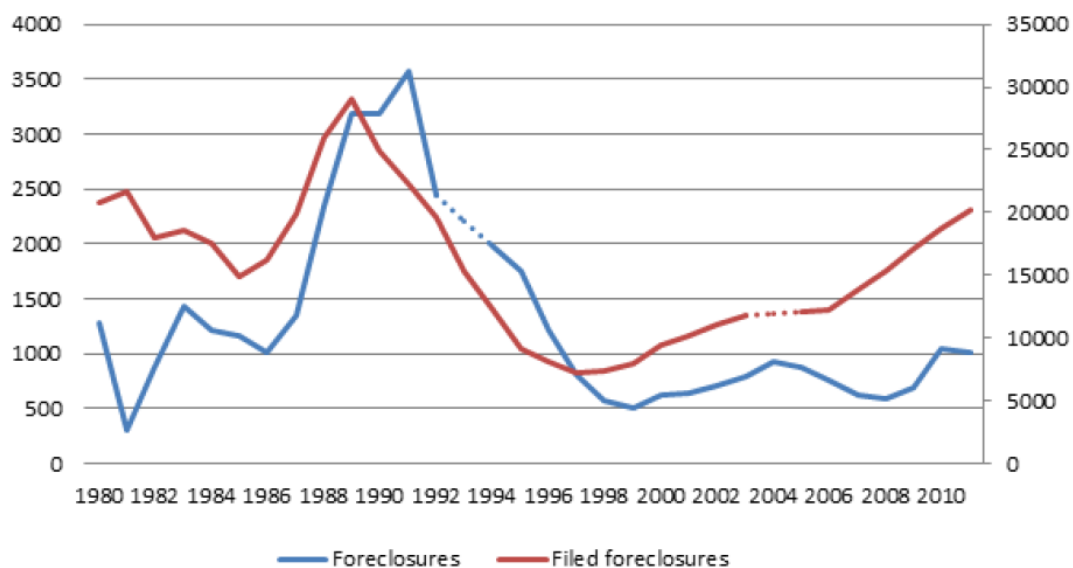
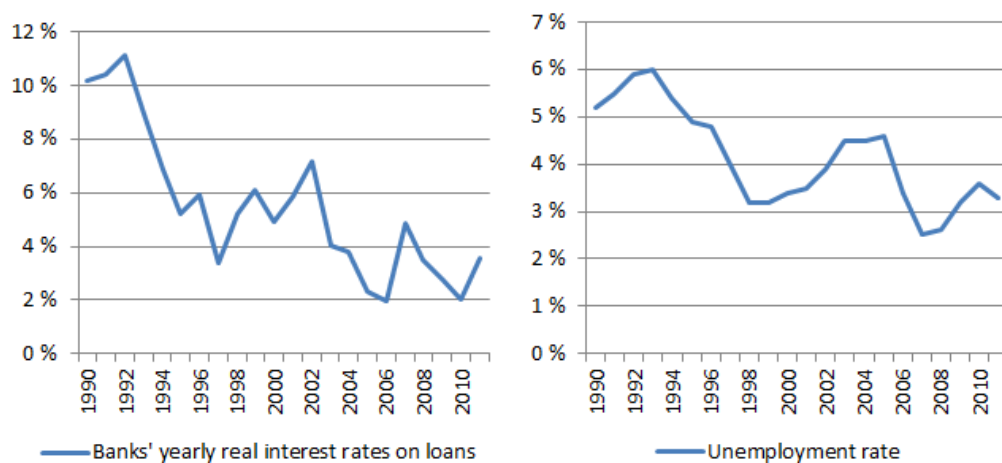


Figure 2: Unemployment and real interest rate 1990- 2011



From Figure 2, we see that over the period 2006 - 2011 both interest rates and the

unemployment rate have been low. Still, Figure 1 shows that during the same period, there has been a sharp increase in the number of filed foreclosures.

Lessons from the Norwegian banking crisis of the late 1980s and early 1990s suggest that the numbers of filed and actual foreclosures may serve as good indicators of debt-vulnerability among Norwegian households. From Figure 1, we see that the number of filed and actual foreclosures increased rapidly during the business cycle downturn in the late 1980s. Before the crisis, households' debt to income ratio reached a level of more than 160 percent, which according to a several authors proved unsustainable as the business cycle turned.¹⁰ At the peak in 1989, about 7 foreclosures were filed per thousand inhabitant. This resembled an increase of 75 percent from 1985. The number of actual foreclosures tripled between 1986 -1989, where more than 3000 houses were foreclosed annually until 1993. This contributed to great losses for the banks, and several banks had to be rescued by the government (Steigum 2004).

Since housing prices and household debt are strongly interrelated, developments in filed foreclosures may also provide useful information about the state of the housing market.¹¹ Already three years prior to the Norwegian housing market crash in 1988, the number of filed foreclosures began to increase. Furthermore, international data on foreclosures show that increases in mortgage arrears, delinquencies and filed foreclosures preceded the recent housing market crash in several countries.¹² The developments during the Norwegian banking crisis and the recent development in other countries suggest that rapid increases in the number of filed foreclosures may serve as a sign of pending losses in the household sector. However, as only a minor share of the foreclosure filings are realized as actual foreclosures, it is important to seek an understanding of the mechanism behind the recent developments before any conclusion can be drawn.

¹⁰For the recent data on household debt to disposable income ratio see Jurgilas and Lansing (2012). Both Schwierz (2004, p 122-124) and Gerdrup (2004) holds this notion. See also the Smith commissions report to the Norwegian parliament, Stortinget (1998).

¹¹See for instance Anundsen and Jansen (2011) for evidence on Norwegian data.

¹²See for instance Mayer, Pence and Sherlund (2009), and Lea (2010).

3 A survey of recent contributions

In the aftermath of the recent financial crisis, a vast literature on the determinants of foreclosures has emerged. The literature has been especially concerned with the large increases in foreclosures in the US following the collapse of the housing market at the end of the previous decade (Mayer, Pence and Sherlund 2009). In general, researchers seem to agree on what are the most important factors driving the number of foreclosures at an aggregate level (Foote et al. 2009, p 5).¹³ Housing prices and households' equity are seen to determine the households' and banks' willingness to maintain the mortgage contract, while negative shocks to income and borrowing constraints affect the households' abilities to do so.

Usually, it is the interplay between social, individual and economic factors that causes a foreclosure (Berry, Dalton and Nelson 2009). Still, in this thesis, the individual and social characteristics of the individuals who get their home foreclosed are not considered in depth.¹⁴ First, both the international literature and the Norwegian literature find an important role for macro-economic factors (Astrup and Holm, 2009; Foote, Gerardi and Willen, 2008). Second, it seems reasonable to assume that the individual characteristics that increase the probability of a foreclosure are fairly stable over time. Thus, in trying to explain different trends in the foreclosure data, I argue that such characteristics become less relevant.

The occurrence of a foreclosure is a result of an interaction between a debtor and one or more creditors with differing interests in a complex institutional setup. Thus, the relevant macro-economic impact on both lender and borrower behavior needs to be considered. In that respect, the impact of a macro-economic variable seems relevant in at least three dimensions. First, a change in a macroeconomic variable may affect the borrowers' willingness to stay in his house, rather than defaulting. Second, it may affect his ability to pay, his cash-flow condition. Finally, it may change the lenders' willingness to adjust or refinance a mortgage.

¹³These findings are also consistent with previous literature such as Kau, Keenan and Kim (1994) and Deng, Quigley and Order (2000).

¹⁴See Astrup (2009) for details on the individual characteristics of those who have their home foreclosed.

3.1 Impact of housing prices and negative equity

Housing price movements are generally identified as one of the most important determinants of defaults and foreclosures. From a theoretical point of view, the expectation of a housing price appreciation will increase debtors' incentives to avoid a default, since it makes the investment backed by the loan more profitable in expectation. In addition, housing prices affect the debtors loan-to-value and hence the share of debtors that have negative equity. When equity is positive, selling the house would naturally tend to be a better option for the borrower than having it foreclosed. Thus negative equity is seen as a necessary condition for a foreclosure to occur, at least in the US (Foote et al. 2009). Moreover, housing price expectations may influence the lenders decision to refinance, or to adjust the terms on the mortgages (Foote, Gerardi and Willen, 2008).

These theoretical considerations are supported by the empirical literature. Danis and Pennington-Cross (2008) use a nested logistic specification to calculate the marginal effect of different factors affecting US foreclosures from 1996 – 2003. The authors find that a one standard deviation decline in housing prices increases the probability of a default by 10 percent.¹⁵ Changes in housing prices is found to be the primary determinant of foreclosures in Sherlund (2008). He uses a competing hazard model for the period 1992—2007, where a large number of loan characteristics, such as the loan to value, credit scores and interest-only features are available at the individual level.

Foote, Gerardi and Willen (2008) also find an important role for housing prices, but mainly through their effect on households' loan-to-value. The authors exploit a data set with individual data on household equity from 1987 – 2007 in Massachusetts. The factors affecting foreclosures are computed in a proportional hazard model, where the explanatory variables affect the likelihood of a foreclosure relative to a baseline hazard of a default. The authors find that negative equity, *ceteris paribus*, will contribute to increase the relative hazard of a foreclosure rapidly. A borrower with ten percent negative equity is five times as likely to default as a borrower having 25 percent positive equity.

Yet, among the households experiencing negative equity, the number of foreclosures is

¹⁵However, their measure of housing prices is not at an individual level, which means that there might be substantial measurement error. To account for this, they include the standard error of housing prices in different areas and find that a one standard deviation increase in the volatility of housing prices increases the probability of default by 41 percent.

relatively low.¹⁶ Thus, in order to fully understand how housing prices and equity affect foreclosures, it is important to see this equity condition in combination with factors affecting households' cash flow. Generally, the literature finds that increases in unemployment rates, and interest payments increases the number of defaults.¹⁷ A higher unemployment or interest rate will be particularly problematic in combination with falling housing prices. In such an environment, a homeowner receiving a negative income shock is more likely to have negative equity. This negative equity reduces homeowners' possibilities, as they are unable to sell the house to repay the mortgage, and may be constrained from being offered a refinancing deal (Foote et al 2009, p 17).

Note that for large increases in foreclosures, there might be a two-way causality between housing prices and foreclosures, a point made by Mian, Sufi and Trebbi (2011). By comparing zip codes with different foreclosure laws, but that otherwise are deemed equal judged by a set of relevant characteristics, they identify a discrete jump in the foreclosure propensity in areas belonging to a state with "lax" foreclosure laws relative to a state with "strict" foreclosure laws. The difference in foreclosure laws is then used as an instrument for foreclosures. The authors identify large negative impacts on housing prices, residential investment and consumer demand of an increase in foreclosures.

Interestingly, the connection between housing prices and foreclosures seems to be unrelated to different institutional arrangement. In a paper on mortgage default in Australia, Berry, Dalton and Nelson (2009) find that falling housing prices in combination with an increase in rental prices is an important driver of foreclosures. Their findings, based on a large survey of mortgagors, are relevant for the analysis in this thesis, as the institutional setup in Australia is more similar to Norway than what is the case for the US. Neither in Australia, the UK nor in Norway does the borrower lose his debt obligation after a foreclosure, which is the in several US states. This means that the borrowers in both countries seldom will have an incentive to default on their debt voluntarily. However, falling housing prices still plays a role in Australia, but mainly since highly indebted borrowers have few other options when housing prices are falling (Berry, Dalton and Nelson,

¹⁶Among the borrowers that Foote, Gerardi and Willen (2008) identifies as having negative equity, only about 6, 4 percent experience a foreclosure in the subsequent three years.

¹⁷This point is further elaborated in the next subsection. See Muellbauer and Cameron (1997) and Böheim and Taylor (2000) Li and White (2009) and Astrup and Holm (2009) for the impact of unemployment.

2009).

Aron and Muellbauer (2010) find similar results for the UK over the period 1983 – 2009. Using an equilibrium correction model, they find that a one percent increase in the share of households with negative equity leads to a rise in filed foreclosures of between 0.4 and 0.6 percent. In particular, they find that the effect depends on the length of the payment problems. Furthermore, a one percent increase in the proportion of borrowers with negative equity rises the number of foreclosures by 0.7 percent in the short run, with and time varying long run effect.

In the UK, mortgage borrowers are responsible for their debt obligations for up to six years after the lender has decided to foreclose the house (Aron and Muellbauer, 2010, p 10). In Norway, the condition is even stricter, as the debtor is permanently obliged to his debt after a foreclosure, unless a debt settlement deal is granted.¹⁸ Thus, both in Norway and in the UK, a borrower will seldom be better off by having his home foreclosed. Still, negative equity seems to have strong explanatory power for foreclosures in the UK. Households with negative equity may be constrained from selling their property or refinancing the mortgage and are thus left with few other options than foreclosing on the mortgage. Aron and Muellbauer (2010) also find a significant impact of policies that shifts the forbearance policy of banks, where more forbearance generally lowers the rates of foreclosures. Although it is highlighted as an important determinant, the impact of housing prices in lenders willingness to adjust mortgages is not modeled.

3.2 Impact of shocks to income:

In general, the variability of income will affect borrowers' ability to meet their periodic mortgages installments, and hence affect the probability of a foreclosure. Foote et al (2009) find a strong positive effect of unemployment on defaults for both prime and subprime borrowers in their proportional hazard model.¹⁹ A one percentage point increase in the unemployment rate is found to raise the hazard ratio of about 1.23 percent. A similar result is found in Li and White (2009), although the point estimate is somewhat

¹⁸Tvangsfulbyrdelsesloven 1992: <http://www.lovdatab.no/all/nl-19920626-086.html> Lov om gjeldsordning 1992: <http://www.lovdatab.no/all/nl-19920717-099.html>

¹⁹Surprisingly, both Danis and Pennington-Cross (2005) and Sherlund (2008) find a reduced probability of default when unemployment increases. However, since they both are using aggregated numbers on unemployment, they miss individual variation, which may explain this puzzling result.

lower.

Berry, Dalton and Nelson (2009) argue that a large proportion of Australian households face troubles in maintaining their mortgage payments in case of illness, divorce or unemployment. A similar impact of unemployment is found also for the UK, where Muellbauer and Cameron (1997) and Böheim and Taylor (2000) document a strong negative effect from unemployment based on regional and micro-evidence, respectively.

3.3 Impact of debt and lending standards:

In general, the literature separates the impact of debt into two variables; the loan-to-value (LTV) and the debt-to-income (DTI)-ratio. Higher debt increases the likelihood of negative equity for the borrower, which seems to be one of the major determinants of foreclosures. An increase in household debt will also affect the cash flow constraint of households', since higher levels of debt relative to income increases the periodic amount spent on serving the debt.

Foote et al (2009) estimate that a one percentage point increase in the DTI ratio raises the probability of foreclosure by 1.05 percent for prime borrowers and 8.3 percent for subprime borrowers in the US.

Aron and Muellbauer (2010) look at the impact of the debt service ratio (debt payments including interest as a share of income) in their equilibrium correction setup. They find that a one percentage point rise in the debt service ratio increases the foreclosure rate by almost two percent, while filed foreclosures increase by about 1.6 percent. Interestingly, the long run effect of an increase in the debt service ratio is found to be significant only in the periods 1985-1995, and 2005-2010. This suggest that, as the authors point out, the debt service ratio only affects foreclosures to the extent that households are bounded by a negative cash flow.

In the US, there exists a vast literature on the impact of lending standards on foreclosures. Most studies find that borrowers with higher credit scores have a lower probability of foreclosures, and that subprime mortgages have a much larger tendency of default than prime mortgages (Sherlund, 2008; Danis and Pennington-Cross, 2005 and Gerardi, Shapiro and Willen, 2007).

Thus, based on the results in the literature, there may well be different short and long run effects of debt on filed and actual foreclosures. While increased household

borrowing may temporarily reduce the cash flow constraint, it will increase the DTI ratio, which contributes to making the households more vulnerable to negative income shocks. Interestingly, Sherlund (2008), finds that mortgages with an interest-only-period has a lower default probability during the teaser period compared to standard mortgage contracts, but higher default rates afterwards. This interest-only-period should in theory have the same impact as short term borrowing, and seems to support the notion of possible asymmetric effects of increased debt.

In periods with high housing price expectations, households experience easier access to credit (Anundsen and Jansen, 2011; Borgersen and Sommervoll, 2006). In such periods, previously constrained households may be able to refinance their mortgage in order overcome temporary payment problems that otherwise would lead to an actual foreclosure. However, as their debt level increases they become more vulnerable to income shocks and the likelihood that they will experience negative equity increases. In such a framework, large increases in filed foreclosures relative to actual foreclosures may indicate that an increasing number of households are reaching an unsustainable debt level, which easily is turned into actual forecloses in the event of negative shocks to income or falling housing prices.

3.4 Norwegian literature

The empirical literature on foreclosures in Norway is relatively scarce. That said, there has been quite extensive research on debt serving capacity and recurring payment problems among Norwegian Households (Poppe, 2005; Vatne, 2006 and Guldbrandsen, 1999). Astrup and Holm (2009) are the only authors that have investigated foreclosures in relation to macro-economic variables in Norway. Their analysis consists of a combination of an aggregate time-series approach and micro-data evidence from a sample of Lindorff's data base.²⁰ Surprisingly, the authors conclude that geography and housing prices do not have a direct effect on foreclosures. However, this finding is based on the lack of a connection between foreclosures and centrality, measured in five categories of population densities and is not analyzed over time. A limitation of their analysis is that possible effects of the loan-to-value ratio and changes in housing prices are not included in their

²⁰Lindorff is a provider of debt-related administrative services, such as credit evaluation, invoicing, reminders, and debt collection

models.

Their research does however open for a role of housing prices in affecting banks willingness to extend credit to otherwise constrained borrowers. Interestingly, they find that the DTI ratio is relatively higher among individuals who experience a foreclosure, and their measure of DTI is significant in the time series specification. Furthermore, it is worth noting that those who experience a foreclosure are not different from the population in regards to income, but they tend to be younger than the average borrower and subject to a prior reduction in income.²¹

In an OLS regression on foreclosures, Astrup and Holm (2009) find a strong positive effect from the unemployment rate, while the interest rate is found to be insignificant. Their findings seem plausible as the interest rate tend to move countercyclically, and will be low in times of high unemployment (Astrup and Holm, 2009, p 155). However, due to data limitations, their results are based on only 18 observations from 1990 – 2008 and does not account for housing prices.

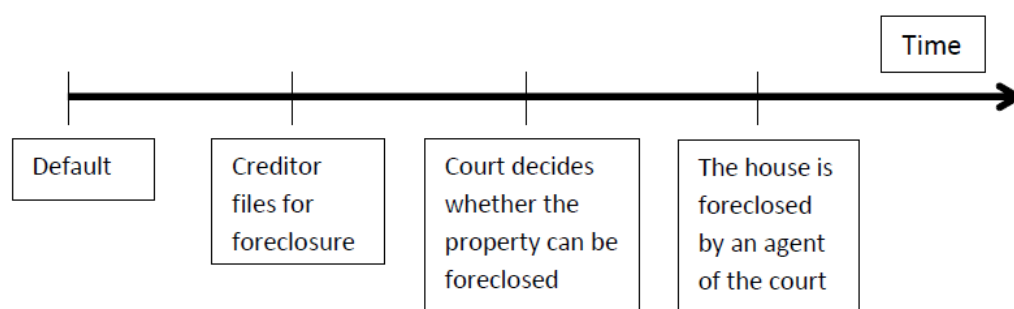
²¹See Appendix B for a more thorough discussion on individual characteristics of those who experience a foreclosure

4 Institutional Framework

A creditor can file for a foreclosure if the debtor defaults on a debt that is secured by collateral. However, if the debtor fails to meet his periodic payments on unsecured debt, the creditor can file the court for a claim in any property the debtor may have. Hence, a debtor that is unable to meet his periodic debt payments may have his property foreclosed regardless of whether the debt was secured or not in the first place.²²

In order to file for a foreclosure, the debtor must have defaulted on his periodic debt payments.²³ Moreover, the bank must argue that several missed payments shows that the debtor is unable to fulfill the original agreement. The debtor will then receive a warning letter stating that his property will be filed for a foreclosure if he fails to pay within two weeks upon receiving the letter. If the debtor still does not pay his debt installment, the petition for the foreclosure will be filed to the court, which then considers whether the property should be foreclosed or not.

Figure 3: Legal procedure



First, the court makes a preliminary trial of the petition to see whether the filed foreclosure can be upheld. When the debtor has responded, or the deadline has expired, the court decides whether the creditor can foreclose the property. An intermediary, a

²²This section is based on the law on foreclosures (tvangsfulbyrdsloven 1992): <http://www.lovdato.no/all/nl-19920626-086.html>, and the law on personal bankruptcies (lov om gjeldsordning 1992) <http://www.lovdato.no/all/nl-19920717-099.html> in addition to information from the court administration in Oslo.

²³The following section consider the procedure when the creditor has secured his debt by a collateral in debtors property

Refinancing	Voluntary sale	Debt settlement	Foreclosure
The debtor can reach a refinancing deal with the bank, get a temporary postponement of his debt payments or take up short term debt to pay his mortgage installments	If the value of the house is greater than the debt, the debtor can sell his property to pay the creditor	Can be granted if the individual is considered permanently unable to repay his debt. In most cases, the debtor is able to keep his house	The debtor's property is sold by an agent for the court
<hr/>			
<i>Property sold?</i>			
No	Yes	No	Yes

Table 1: Possible outcomes after a filed foreclosure

lawyer or a real estate agent, usually facilitates the sale. This intermediary does in many cases attempt to settle an agreement between the parties often involving either a refinancing deal or a voluntary sale of the house (Astrup and Holm 2009). The creditor and debtor are free to negotiate any agreement during the process. A bank may for instance adjust the periodic installments or grant a refinancing deal, secured by the value of any property the debtor may have.

Note that this process usually takes between 8 – 12 months, where in many cases another solution than a foreclosure is found (Astrup and Holm 2009, p 48). Based on data on filed and actual foreclosures, it is clear that roughly five percent of the filed foreclosures end up as actual foreclosures (see Figure 1). Still, a large fraction of households are forced to sell their house due to permanent income setbacks and subsequent failure to pay their mortgage installments. However, in this situation, households have the option to sell instead of having the property foreclosed by court. This *de facto* foreclosure will not appear as a foreclosure in the data, which may bias the foreclosure data downwards. As Astrup and Holm (2009, p 101) argue, it may only be a small practical difference between these “voluntary sales” and the court registered foreclosures. Using data from Lindorff, Astrup and Holm (2009) find that among those that received a filed foreclosure, there were equally many “voluntary sales” as there were actual foreclosures. Thus, in a broad sense, the actual foreclosure numbers are about twice the level they appear in the data.

5 A simple model of foreclosures

In order to reach a more precise understanding of the factors determining the likelihood and outcome of a filed foreclosure, a simple model of foreclosures is presented. The model captures both the household's ability to maintain the contract, through a household cash-flow constraint, and the bank's willingness to refinance in case of a breach of the contract. I find that filed foreclosures are mainly affected by the borrower's debt-to-income ratio, while the occurrence of an actual foreclosures depends on a "double trigger". That is, an actual foreclosure is realized only if a household experience an income setback and the expected value of the collateral is too small for a refinancing deal to be preferable the bank.

The model is consistent with the implications the model of Borgersen and Sommervoll (2006), where housing price expectations determines the available credit for the households through their collateral. However, the model moves beyond this framework to look more specifically at the interplay leading to a foreclosure. The theoretical framework builds upon Foote et al. (2009), but is adjusted to fit the Norwegian institutional framework. Furthermore, the households cash-flow condition is modeled explicitly. This structure, I argue, shed more light on how filed and actual foreclosures are affected by households' ability pay in addition to the households' and the banks' willingness to uphold the contract.

5.1 Timeline and model description

Consider a representative household that in period $t = 0$ seek a mortgage M_0 from the bank to buy a house at a price P_0 . The amount to be paid back during the duration of the contract is given by $L = (1 + r)M_0$, which is repaid in two installments: $m_1 = \delta M_0$ in period $t = 1$ and $m_2 = (1 + r)M_0 - \delta M_0$ in period $t = 2$. Thus, we have that:

$$L = (1 + r)M_0 = m_1 + m_2 \tag{1}$$

The interest rate, r , is defined as the interest earned after the bank has discounted the payment. Note that r is only paid on the period $t = 2$ installment. The contract

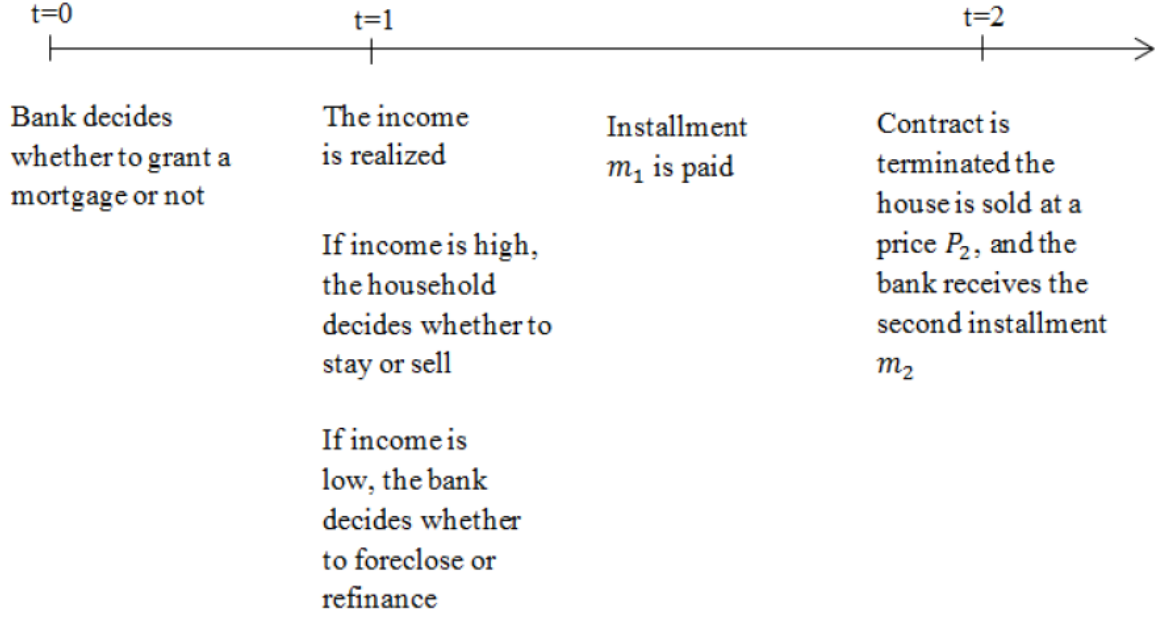


Figure 4: Timing of events

is terminated in period $t = 2$, when the household sells his house and the final debt is repaid.

In period $t = 0$, the bank chooses whether to grant the mortgage M_0 for a purchase of the house at value P_0 . The agent earns a gross income less some minimum consumption of y^s in period $t = 1$. The income, y^s , is stochastic and is realized in period $t = 1$. The income can take two values, and is given by:

$$y^s = \left\{ \begin{array}{ll} y^h = L & \text{with probability } \lambda \\ y^l = 0 & \text{with probability } (1 - \lambda) \end{array} \right\} \quad (2)$$

The high income, y^h , is assumed to be sufficient to cover the entire mortgage payment L , while the low income, y^l , is assumed to be 0, i.e. realized income only covers some minimum consumption level. In order for the agent to uphold his mortgage agreement in period $t = 1$, his net income cannot exceed the periodic mortgage installment m_1 . Thus, in order to reach the contracted agreement, the agent needs to satisfy the following cash-flow constraint.

$$y^s \geq m_1 \quad (3)$$

As the high income is sufficient to repay the entire mortgage, a realization of this income

level enables the agent to pay according to the contracted agreement. Thus, the high income ensures that the household may chose to stay in the house and repay the total amount, including interests, L , to the bank in period $t = 2$, or sell the house at a price P_1 in period $t = 1$. Since the income is sufficient to repay the mortgage, the household holds the entire value of the house in period $t = 2$ if he chooses to stay in the house.

The low income is, however, only sufficient to cover the household's minimum consumption level, so that $y^l = 0 < m_1$. Thus, when the low income is realized the agent will not be able to pay the periodic mortgage installment stipulated by the contract. Consequently, when y^l is realized the bank chooses in period $t = 1$ whether to foreclose the property, or to offer a refinancing deal.

Figure 5 illustrates the five different outcomes of this model, which – as discussed above -depends on the state of income and the choices of the household and the bank.

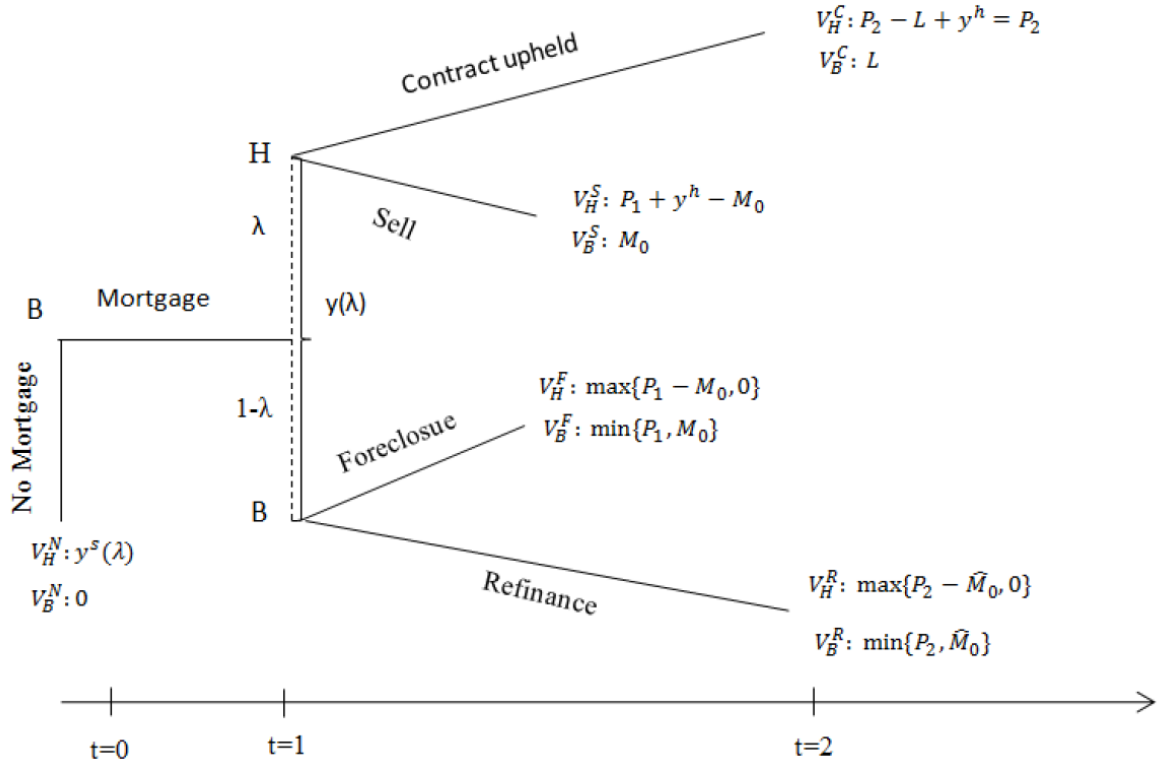


Figure 5: Structure of the game

1. **No mortgage:** The bank does not grant M_0 , which means that the household receives the expected income, and the bank receives nothing.
2. **Voluntary sale:** The bank grants a mortgage M_0 in period $t = 0$, the high income,

y^h , is realized, and the household chooses to sell the house at a value P_1 in period $t = 1$. The household receives $P_1 - M_0 + y^h$, and the bank receives M_0

3. **Contract upheld:** The bank grants a mortgage M_0 in period $t = 0$, the high income is realized and the contract is upheld. The household receives the P_2 in period $t = 2$ and the bank receives the contracted mortgage payment, L .
4. **Refinance:** The mortgage is granted in period $t = 0$, the low income is realized and the household gets a refinancing deal by the bank in period $t = 1$. The household is expected to make a mortgage payment $\widehat{M}_0 > M_0$ in period $t = 2$, which is backed by the expected housing value at $t = 2$.
5. **Foreclosure:** The mortgage is granted in period $t = 0$, the low income is realized and the house is foreclosed by the bank in period $t = 1$. The household receives the remaining value of the house after paying the mortgage $\max[P_1 - M_0, 0]$, and the bank receives M_0 , or the value of the house if selling the house does not provide sufficient funds to repay the mortgage, $\min[P_1, M_0]$

5.2 The household's payoff for different outcomes

Contracted payment

The household seeks the bank for a mortgage M_0 in period $t = 0$ in order to purchase a house at a price P_0 . In period $t = 1$, the high income is realized and the household chooses between staying in the house and committing to the contract, or to sell the house at a price P_1 . In period $t = 1$, sticking to the contracted payment gives the following expected value for the household:

$$V_h^C = E_1(P_2) - L + y^h = E_1(P_2) \quad (4)$$

Voluntary sale

The household chooses to sell the house at a price P_1 in period $t = 1$ and repay the mortgage M_0 to the bank. A voluntary sale gives the following payoff for the household in period $t = 1$:

$$V_h^S = P_1 + y^h - M_0 \quad (5)$$

Refinancing

Under refinancing, the net income is given by $y^l = 0$. Consequently, the household is unable to pay the mortgage installment in period $t = 1$ (the cash flow constraint fails to be met). However, the household still owes the bank the mortgage M_0 . For the bank to be willing to offer a refinancing deal the household must agree to repay $\widehat{M}_0 = (1 + \bar{r})M_0 > M_0$ in period $t = 2$, which is collateralized by the period $t = 1$ expected housing value in period $t = 2$:

$$V_h^R = \max[E_1(P_2) - \widehat{M}_0, 0] \quad (6)$$

$$\widehat{M}_0 = (1 + \bar{r})M_0 \text{ where } \bar{r} > 0. \quad (7)$$

The condition in (7) is necessary to ensure that the bank strictly prefers a refinancing deal to a foreclosure when the household has positive equity. The assumption entails that the bank must earn a positive interest, \bar{r} on the mortgage in order to be willing to take the risk of offering a refinancing deal.

Foreclosure

If the low income state is realized, and the bank chooses to foreclose the house, the household receives the difference between the housing value and the mortgage, $P_1 - M_0$, as long as the housing value exceeds M_0 . The household receives 0 otherwise. That is, the household is in this model only obliged to a mortgage that is covered by the housing value (limited liability).²⁴ Let V_h^F denote the household's utility from a foreclosure. We then have

$$V_h^F = \max(P_1 - M_0, 0) \quad (8)$$

5.3 The household's decision to stay or sell

In period $t = 1$, the income is realized. The realization of the high income state, allows the household to choose whether it wants to stay in the house and pay according to the

²⁴This condition is somewhat laxer than in reality. In Norway the debtor is obliged to his entire mortgage even after a foreclosure. However, it may take long time before the bank receives the remaining debt. Furthermore, the debtor has the opportunity to seek a debt settlement in which the remaining debt is written off over a five year period

contract, or to sell the house. In order for the household to be willing to stay in the house in period $t = 1$, the value of upholding the contract must exceed the value of selling the house in period $t = 1$. That is:

$$V_h^C > V_h^S \Leftrightarrow E_1(P_2) - L + y^h > P_1 + y^h - M_0$$

$$E_1(P_2) - P_1 > rM_0 \tag{9}$$

From (9) we see that the household will stay in the house until period $t = 2$ and commit to the contract if the expected housing price appreciation from period $t = 1$ to period $t = 2$ exceeds the interest paid on the mortgage over that period.

5.4 The bank's payoff

The bank decides in period $t = 0$ whether to grant the loan or not. If the loan is granted, the bank receives the contracted payment L if in period $t = 1$ the high income state is realized and the household chooses to uphold the contract. In the case were the household decides to sell the house in period $t = 1$ the bank receives M_0 . If the low income state is realized, the bank chooses in period $t = 1$ between offering a refinancing deal or to foreclose the property.

Refinance

In period $t = 1$ the bank can choose to offer a refinancing deal to the household instead of foreclosing the house when $y^s = y^l$. Even though the household cannot promise to repay the mortgage based on his income (which is zero), part of the value of the house in period $t = 2$ can be used to repay the bank in that period. Hence, it is possible for the bank to offer a refinancing deal from which it gains relative to a foreclosure. By choosing refinancing, the bank requires a payment $\widehat{M}_0 = (1 + \bar{r})M_0$. However, if the housing value in period $t = 2$ falls short of this payment, the bank will only receive the period $t = 2$ housing value P_2 . In expectations, the value for the bank of a refinancing deal can be written as:

$$V_b^R = \min[E_1(P_2), \widehat{M}_0] \tag{10}$$

Foreclosure

We assumed that the household's income is zero after covering a minimum level of consumption, that is when $y^s = y^l$. Thus, when foreclosing the house, the bank gets the entire mortgage M_0 from the period $t = 1$ housing value P_1 . In the case where the value of the house is not sufficient to cover M_0 ($M_0 > P_1$), the bank can only claim the value of the house, P_1 . With these assumptions, the bank will only get the full principal of the mortgage back from a foreclosure if the housing value is at least as great as the mortgage, i.e. when the borrower has positive equity. This means that the banks payoff function under a foreclosure can be written as:

$$V_b^F = \min[M_0, P_1] \quad (11)$$

5.5 The bank's decision to file for a foreclosure

When the low income state occurs, the household fails to meet his periodic debt installment, and the bank can file for a foreclosure. I assume that the bank will file for a foreclosure regardless of whether it ends up offering a refinancing deal or chooses to foreclose.²⁵ Thus, when the cash-flow condition (3) is violated, the bank files for a foreclosure. By substituting for $m_1 = \delta M_0$ in (3), we see that if $y^s < \delta M_0$, the bank files for a foreclosure, which obviously will be the case when $y^l = 0$. In a more general setting, it is reasonable to assume that the income is drawn from a continuous distribution on the interval $[y^l, y^h]$. In that case, the installment $m_1 = \delta M_0$, determines the likelihood of a filed foreclosure for a given realization of household income. Consequently, filed foreclosures can be seen as a function of the household debt relative to household income and how "frontloaded" the mortgage is. Theoretically, we would therefore expect that filed foreclosures are determined by a function of the following form, where y is some income realization on the interval $[y^l, y^h]$:

$$Filed(\bar{y}, \bar{M}_0^+, \bar{\delta}^+) \quad (12)$$

²⁵This assumption may be reasonable as the file for a foreclosure in reality helps the bank to reveal the household's true state of income. This possibility limits any problems of asymmetric information between household and bank in the event of debt default

5.6 The bank's decision to refinance

In order for the bank to prefer a refinancing deal to a foreclosure, it must in $t = 1$ expect to receive more from a refinancing deal than a foreclosure, i.e. $V_b^R > V_b^F$. This will depend on whether the housing value in period $t = 1$ exceeds the outstanding mortgage ($P_1 > M_0$), or whether the housing value in period $t = 1$ falls short of the outstanding mortgage ($P_1 < M_0$). In the following, the first case is referred to as the household having *positive equity* (Pe) and the second case as *negative equity* (Ne). Assume that the value of P_1 is known to the bank when it makes its decision.

In the case of positive equity in period $t = 1$, the bank chooses between receiving the full principal M_0 immediately, or receiving the payment $\min[E_1(P_2), \widehat{M}_0]$ in period $t = 2$.

Case 1

$V_b^R > V_b^F$ if $\min[E_1(P_2), \widehat{M}_0] > M_0$. As, V_b^R is a non-decreasing function of $E_1(P_2)$ the condition can be written as $E_1(P_2) > M_0$.

The period $t = 1$ expected housing value for period $t = 2$ must exceed the mortgage value in order for the bank to offer a refinancing deal. That is, the bank will never be willing to refinance if it expects that the household has negative equity in the next period.

Case 2

$V_b^R > V_b^F$ if $\min[E_1(P_2), \widehat{M}_0] > P_1 \Rightarrow E_1(P_2) > P_1$.

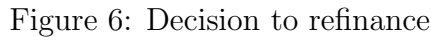
In this case, the period $t = 1$ expected housing value for period $t = 2$ must exceed the housing value in period $t = 1$. Thus, the bank must expect a housing price appreciation, in order to be willing to offer a refinancing deal when the household has negative equity.

We see that the bank is more willing to offer a refinancing deal when the household has negative equity. This is because the bank has a smaller alternative cost when the equity is negative. That is, the bank receives a smaller payoff from a foreclosure when the household has negative equity. For that reason, a smaller payoff in the period $t = 2$ is required for the refinancing deal to be profitable for the bank ex ante. Note, however, that a household experiencing negative equity will obtain a refinancing deal only when the bank expects housing prices to appreciate. The bank's decision to refinance can be

$$\text{Refinance} = V_b^R - V_b^F = \min[E_1(P_2), \widehat{M}_0] - \min[M_0, P_1] \quad (13)$$

, which suggests that the decision to refinance can be summarized by the following function:

An expected housing price inflation, increases the banks willingness to offer a refinancing deal, while a higher initial mortgage, M_0 , and period $t = 1$ housing price, P_1 , reduces its willingness to do so.



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5.7 Determinants of filed and actual foreclosures

The model presented in the previous sections establishes a conceptual framework for the expected determinants of the number of filed foreclosures, and under what conditions a filed foreclosure is realized as an actual foreclosures. As seen in the previous discussion, a filed foreclosure will happen when the household's income falls short of the contracted mortgage installment. Thus, the number of filed foreclosures can be written as a function (12), depending on the level of household debt and the level of household income. In practice, this means that factors such as unemployment, household income, the interest rate and household debt affects the numbers of filed foreclosures at an aggregate level, while housing prices should play a lesser role. Note that in reality, households may seek additional lending from other sources *before* the bank files for a foreclosure. Whether a household is able to obtain such a loan will depend on the expected housing value (confer the discussion in Section 5.6).

Thus, expected housing prices may have an influence on filed foreclosures even though it is not directly incorporated into the model section.

A filed foreclosure will only be realized as an actual foreclosure if the bank is unwilling to refinance the mortgage. Thus the number of actual foreclosures can be written as an equation:

$$\text{Foreclosures} = \text{Filed}(y, M_0) - \text{Refinance}(\bar{M}_0, \bar{P}_1, E_1^+(P_2)) \quad (15)$$

The number of actual foreclosures depends on the number of filed foreclosures, in addition to the variables determining the bank's willingness to offer a refinancing deal. The willingness to extend a refinance deal should therefore depend on the expected housing prices and the size of the household's debt.

According to the model, a household facing a negative income shock can borrow on its house to overcome the setback, and thus avoid a foreclosure. However this possibility is reduced the higher is the value of their total debt. The larger their debt becomes, the more dependent are the households on positive housing price expectations in order to avoid a foreclosure.

From that perspective, it is possible to understand how large increases in filed foreclosures can happen without causing large increases in actual foreclosures. When the household debt burden increases, more people will fail to meet their periodic debt installments, and the number of filed foreclosures will, *ceteris paribus*, increase. However,

as long as the lenders expect housing prices to increase, they may be willing to offer a refinancing deal in order to obtain value from the housing price increase. In the situation of large increases in filed foreclosures, the sustainability of the households' debt burden is crucially dependent on expectations of higher housing prices.

Finally, two additional important points are worth emphasizing. First, both the willingness to refinance and the willingness to grant mortgages depend on expected housing prices (See Appendix C). Thus, large increases in foreclosures would tend to coincide with low demand of housing among credit constrained households. Second, the households willingness to stay in the house depends on the expected housing price appreciation relative to the cost of the mortgage. That is, in the case of falling housing price expectations, a larger number of voluntary sales among the "high income group" would coincide with an increased number of foreclosures.

6 Data and methodology

The analysis in this thesis builds on a new data set gathered by the author on filed and actual foreclosures spanning the period 1980 -2011 for the 19 Norwegian counties. The new data set allows me to expand the analysis of Astrup and Holm (2009). First, the data set has a larger number of observations due to the panel structure. Hence, the impact of time-varying macroeconomic factors on foreclosures may be more rigorously assessed. More explanatory variables are included, such as housing prices and debt, and the econometric models are specified in order to capture any differences between short and long run effects. Second, the data set allows for an analysis of both the developments in actual foreclosures and in filed foreclosures. This is particularly important as increases in filed foreclosures tend to lead the increases in actual foreclosures.

A description of the data set and the characteristics of those who have their homes foreclosed are given in the Appendix A. This section begins by looking at the long run developments in the data-series and proceeds to describe the empirical methodology used in this thesis.

6.1 Trends in filed and actual foreclosures:

From 2006 to 2011, the number of filed foreclosures increased by more than 60 percent at the national level. As can be seen from Figure 7, the increase in filed and actual foreclosures is apparent also when controlling for banks' total loans to households. That is, the increase in filed and actual foreclosures cannot solely be attributed to the increased volume of loans in itself.

Figure 7: Filed and actual foreclosures as a share of real total lending



The number of filed and actual foreclosures per million kroner lent, adjusted for inflation. Total lending includes lending from banks, mortgage companies and finance companies

The numbers show that a relative small fraction of the filed foreclosures has ended up as actual foreclosures in recent years, while about 15 percent of the filed foreclosures were realized during the banking crisis of 1988-1993. These numbers are surprisingly low, and suggest that many debtors prefer a voluntary solution to their debt problems rather than having their house foreclosed. Yet, as Astrup and Holm (2009) point out, many households avoid a foreclosure by selling their house outside the court, even though this sale is made necessary due to defaulted debt.

Regional variation:

There are considerable regional variations in the growth in filed foreclosures from 2006 –

2011, with some regions having experienced more than a doubling in the number of filed foreclosures over the six year period between 2006 and 2011. From Figure 9, it is evident that the level of filed foreclosures per capita is closely correlated with the unemployment rate. That said, over the period 2006-2011 the unemployment rate has in general fallen, while the numbers of filed foreclosures has continued to increase. Thus, the level of unemployment cannot by itself explain the variation over time in filed foreclosures. Moreover, from 2006 – 2011, the unemployment averaged at 2.5 percent and the nominal interest rate has averaged at 3 percent ²⁶. Thus, given the relatively favorable macroeconomic situation, the developments in the foreclosure numbers are surprising.

Figure 8: Regional growth in filed foreclosures

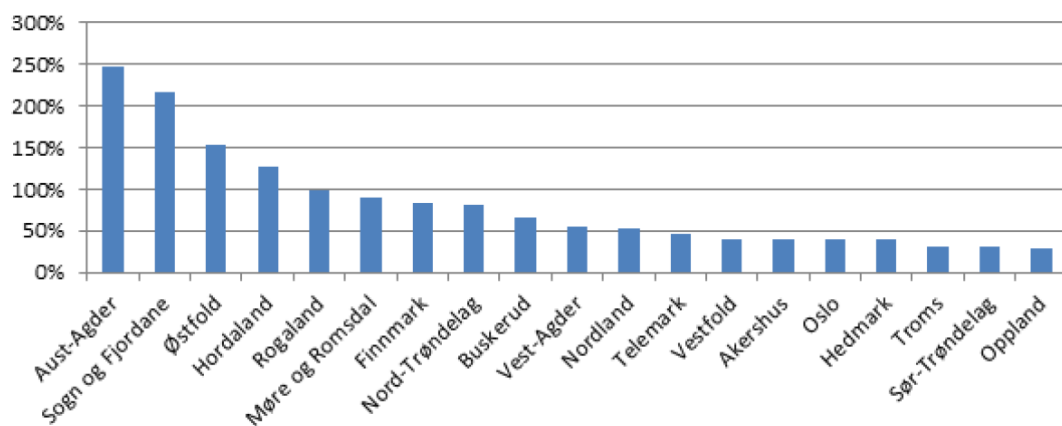
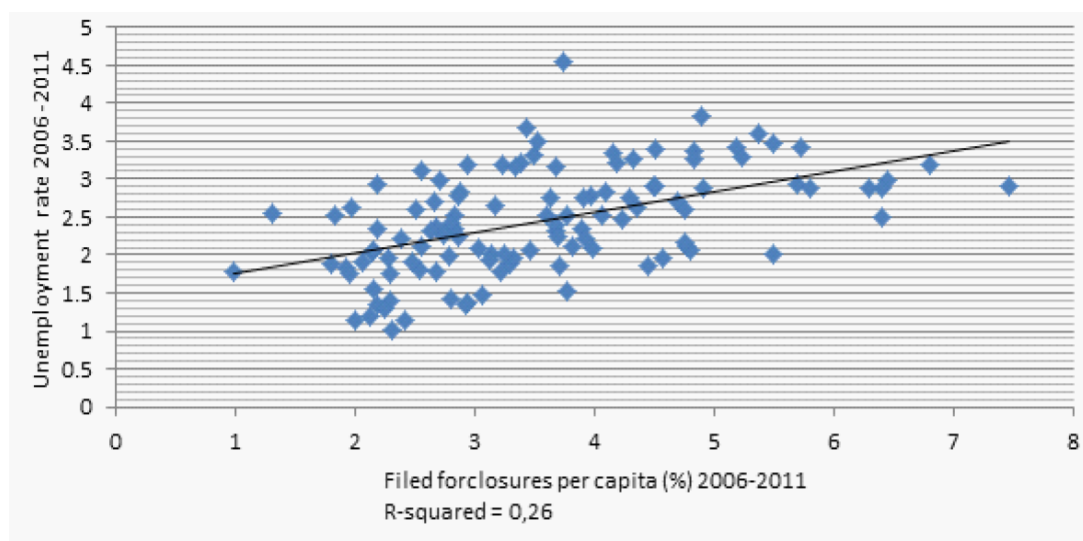


Figure 9: Filed foreclosures and the unemployment rate



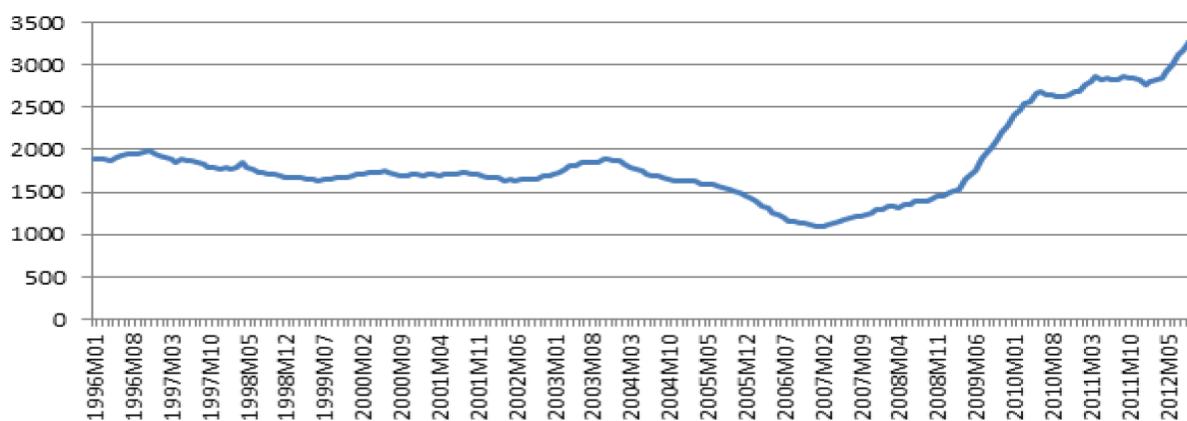
²⁶The nominal interest rate refers to the slight deposit rate (key policy rate), source: Statistics Norway

Foreclosures as an indicator of debt-vulnerability?:

In my view, lessons from the Norwegian banking crisis in the late 1980s suggest that the number of filed and actual foreclosures serve as good indicators of economic distress among Norwegian households. From Figure 7, we see that the number of filed and actual foreclosures increased in the late 1980s. In 1987 real housing prices fell while real after-tax interest rates and unemployment rose substantially during the business cycle downturn (Steigum 2004).

Before the crisis, households' debt-to-income ratio reached a level of more than 160 percent, which according to several authors proved unsustainable as the business cycle turned.²⁷ The number of foreclosures per krone lent (adjusted for inflation) increased with an astonishingly 75 percent over the period 1986-1989. At the peak in 1989, about 7 foreclosures were filed per million krone lent. The number of actual foreclosures tripled from 1986 – 1989, where more than 3000 houses were foreclosed annually until 1993. Thus, in a historical perspective, it seems likely that a large increase in foreclosures reflects a growing debt-vulnerability among the households.

Figure 10: The number of execution procedures



12 month moving average (centered) in the development in creditor's demands on debtor's property caused by defaulted debt. Source: Statistics Norway

The recent increase in filed foreclosures can also be seen in relation to the number of registered execution procedures. These execution procedures reveal the number of cases

²⁷For the recent data on household debt to disposable income ratio see Jurgilas and Lansing (2012). Both Schwierz (2004, p 122-124) and Gerdrup (2004) holds this notion. See also the Smith commissions report to the parliament (1998).

where a creditor makes a claim on any property the debtors may have, both real estate and other. Such procedures are taken out on loans without security, such as credit card loans or consumer loans after the debtor has failed to meet his periodical payments. Figure 10 reveals a more than a 100 percent increase in these numbers from late 2008. Thus, it appears that an increasing number of households are unable or unwilling to maintain their short term debt burden.

Secondly, there seems to be a close connection between filed foreclosures in Norway and households' ability to pay their bills. Figure 11 plots filed foreclosures as a share of total lending on the right axis, and SIFOs measure of recurrent payment problems on the left axis.²⁸ We see that these two variables reveal the same trend the last six years, which indicates that the increase in filed foreclosure reflects reduced ability to pay among households.

Figure 11: Filed foreclosures and the share of households with recurring payment problems



Recurrent payment problems measures the share of households stating that they have sometimes or often been unable to pay their bills, interest payments or mortgage installments the last year. See Poppe(2011)

²⁸SIFO - Statens institutt for forbruksforskning

Foreclosures and the housing market:

Figure 12 indicates a negative correlation between real housing prices and actual foreclosures, as is found in many other countries (See Section 3). Falling housing prices seem to be followed by increases in actual foreclosures. The negative connection does not only hold in the time dimension. As can be seen from Figure 13, the regions with the highest housing prices in 2011, are also the regions with the lowest rates of foreclosures per capita.

Figure 12: Number of actual foreclosures and real housing prices

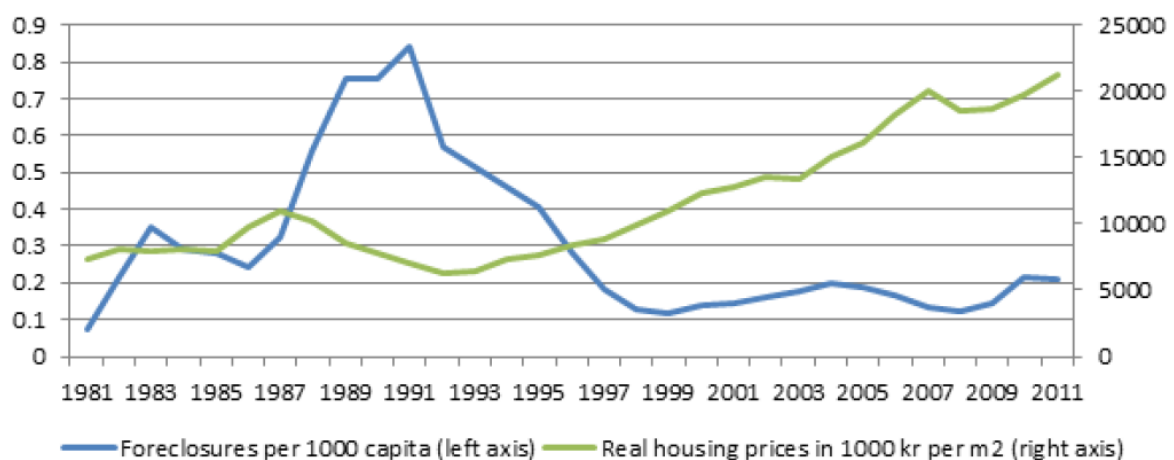
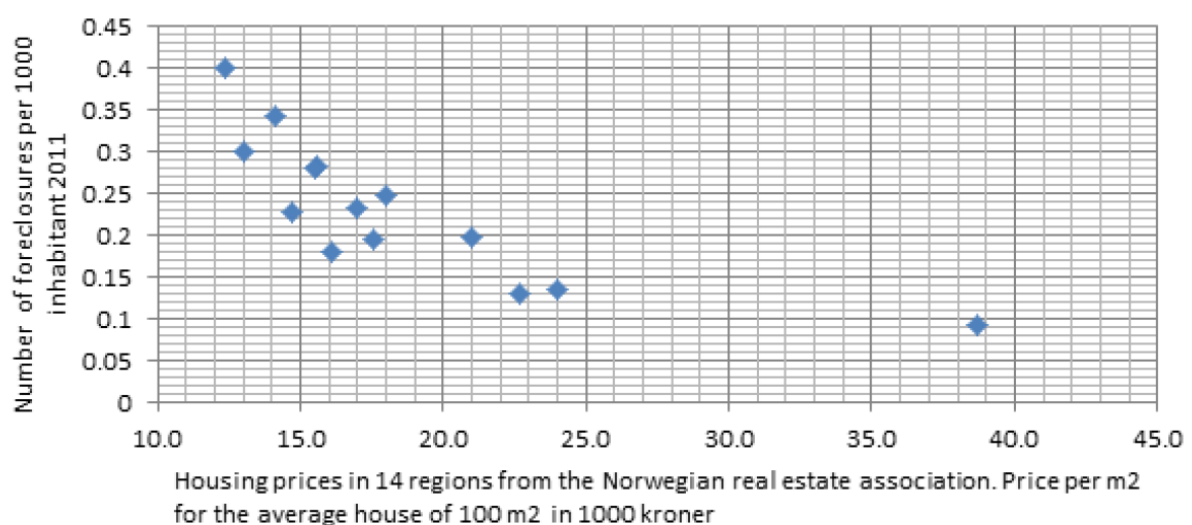


Figure 13: Actual foreclosures and housing prices 2011



Summary:

Lessons from the Norwegian banking crisis of the early 1990s suggest that filed foreclosures may serve as a good indicator of debt-vulnerability among Norwegian households. Such an interpretation is supported by the conspicuous correlation between filed foreclosures, recurrent payment problems and registered execution procedures. Actual and filed foreclosures seem to be related to the business cycle and especially the housing market. Yet, neither the developments in unemployment nor the interest rates appear to be able to fully explain the recent period of increase in filed and actual foreclosures. Finally, the increase in filed foreclosures has not been followed by an equal increase in actual foreclosures.

From the data-plots above, preliminary conclusions can be drawn that suggest interesting hypotheses that may be confronted with the data more formally. First, I ask to what extent the recent increase in filed foreclosures is driven by the increase in household debt burden. Second, I ask why so few filed foreclosures end up in actual foreclosures, and whether part of this may be attributed to the recent years' growth in housing prices?

6.2 Methodology

Stationarity and non-stationarity

The assumptions of the classical regression model requires that the disturbances of the model follows a stationary process. The term stationarity usually refers to the concept of weak stationarity, or covariance stationarity, where the variable's first two moments and its auto-covariance are time invariant (Enders 2004, p 53). For a variable y_t , these requirements may formally be expressed as:

1. $E(y_t) = E(y_{t-s}) = \mu \quad \forall s$
2. $Var(y_t) = Var(y_{t-s}) = \sigma_y^2 \quad \forall s$
3. $Cov(y_t, y_{t-s}) = cov(y_{t-j}, y_{t-j-s}) = \gamma_s \quad \forall s$

Consequently, if the first two moments, or the auto-covariance is time-dependent, the variable is said to be non-stationary. As shown by Granger and Newbold (1974), two

variables that are non-stationary, and do not share a common stochastic trend, may yield a spurious relationship that appears significant, but is without economic meaning. Furthermore, the variance of a non-stationary series is time-dependent, causing the usual hypothesis tests, such as t-test, F-test and R^2 to be invalid (Enders 2004, p 171). To see this, consider the following example:

Let x_t follow an $AR(1)$ process:

$$x_t = \rho x_{t-1} + e_t \quad \text{where } e_t \sim iid N(0, \sigma^2)$$

Solving this recursively

$$x_t = \rho^2 x_{t-2} + \rho e_{t-1} + e_t$$

$$x_t = \rho^3 x_{t-3} + \rho^2 e_{t-2} + \rho e_{t-1} + e_t$$

$$x_t = \rho^k x_{t-k} + \sum_{j=0}^{k-1} \rho^j e_{t-j} \quad (16)$$

Assume that $-1 < \rho < 1$ and let $k \rightarrow \infty$:

$$\begin{aligned} x_t &= \sum_{j=0}^{\infty} \rho^j e_{t-j} \\ E(x_t) &= 0 \\ var(x_t) &= var\left(\sum_{j=0}^{\infty} \rho^j e_{t-j}\right) = \sum_{j=0}^{\infty} \rho^{2j} var(e_{t-j}) = \frac{\sigma^2}{1 - \rho^2} \end{aligned}$$

We see that both the mean and the variance are time independent as k approaches infinity. When $\rho < |1|$, x is thus said to be stationary

Let instead x_t be a random walk and assume that the initial value x_0 is given, we have:

$$\begin{aligned} x_t &= x_0 + \sum_{j=0}^{k-1} e_{t-j} \\ E(x_t) &= x_0 \\ var(x_t) &= var\left(\sum_{j=0}^{k-1} e_{t-j}\right) = \sum_{j=0}^{k-1} var(e_{t-j}) = k\sigma^2 \end{aligned}$$

We see that the variance of x_t increases over time and in fact approaches infinity, as $k \rightarrow \infty$. When x_t follows a random walk, it is said to contain a unit root. Thus, in the presence of a unit root, the series is non-stationary and does not have a finite variance.

Order of integration

A non-stationary variable is said to be integrated of order one, $I(1)$, if differencing it once

leads to a stationary process. We see that even though x_t is non-stationary series when $\rho = 1$, it becomes stationary after taking the first difference:

$$\begin{aligned}\Delta x_t &= x_t - x_{t-1} = e_t \\ E(\Delta x_t) &= 0 \\ \text{var}(\Delta x_t) &= \text{var}(e_t) = \sigma^2\end{aligned}$$

The concept of integratedness can be extended to the general case: A time series is said to be integrated of order d if $(1 - L)^d X_t$ is integrated of order 0. Here, L is a lag operator, so that $(1 - L)X_t = X_t - X_{t-1} = \Delta X$. Consequently, the order of integration, $I(d)$, of a time series refers to the minimum number times the series must be differenced to obtain a stationary series. A series that is stationary is referred to as $I(0)$, i.e. it is stationary without differencing.

Cointegration

For ordinary least squares to give meaningful results, it is essential that the equation under consideration is balanced (Granger, 1990). A balanced equation requires that the variable we seek to explain has the same time series properties as the variables we use to explain that variable with. With reference to equation (18) below, we say that the model is balanced if y_t and x_t have the same order of integration.

Since any linear combination of two stationary variables is also stationary, we know that the disturbance in (18) will be $I(0)$ if both x_t and y_t are $I(0)$, which is necessary for OLS to satisfy the Gauss-Markov theorem. In the case where y_t is $I(0)(I(1))$ and x_t is $I(1)(I(0))$, (18) will not represent a balanced equation, and OLS breaks down.

Finally, when both x_t and y_t are $I(1)$, (18) is a balanced equation. That said, the disturbance will in general be $I(1)$, since in most cases a linear combination of a set of $I(1)$ variables will be $I(1)$ as well. In that case, OLS would not produce estimators that satisfy the BLUE property. That said, even if a set of variables are non-stationary, for instance $I(1)$, a linear combination of these variables may be stationary. In that case, the variables are said to be cointegrated. When a set of variables are cointegrated, they are said to share a common stochastic trend, which means that they will never drift "too" far apart. Another way to think about this is that cointegration implies that a long-run relationship between the variables exists, so that any deviation from this relationship is temporary. With reference to equation (18), if x_t and y_t are both $I(1)$, but cointegrated,

we know that the disturbance is $I(0)$, and hence that OLS will give estimators that are BLUE. Formally, following the definition of Engle and Granger (1987) definition, a vector of variables, \mathbf{x}_t , are said to be cointegrated of order (d, b) , denoted $\mathbf{x}_t \sim CI(d, b)$ if

1. All components of \mathbf{x}_t are integrated of order d
2. There exists a vector $\boldsymbol{\beta} = (\beta_1, \beta_2 \dots \beta_n)$ such that the linear combination $\boldsymbol{\beta}\mathbf{x}_t = \beta_1 x_{1t} + \beta_2 x_{2t} + \dots \beta_n x_{nt}$ is integrated of order $(d - b)$ where $b > 0$

To see what this definition means, consider the following autoregressive distributed lag (ARDL) model as an example:

$$y_t = a_0 + b_0 x_t + b_1 x_{t-1} + a_1 y_{t-1} + e_t \quad (17)$$

Assume that both y_t and x_t are $I(1)$ variables. Yet, a linear combination of the variables form a cointegrated relationship, as specified below.

$$y_t = \beta_0 + \beta_1 x_t + u_t \quad (18)$$

Since y_t and x_t are cointegrated, $y_t - \beta_0 - \beta_1 x_t = u_t$ is by definition integrated of order zero, $I(0)$. Thus, the system is in equilibrium whenever $y_t - \beta_0 - \beta_1 x_t = 0$. The deviation from the long run equilibrium -called the equilibrium error - can be represented by the error term u_t ,

Equilibrium correction representation

A main feature of a cointegrating relationship is that the time paths of the variables are affected by the deviation from the long run relationship. This feature allows for the cointegrated relationship to be represented as an equilibrium correction model (ECM) (Engle and Granger, 1987). This representation captures how the short run dynamics of the variables are affected by any deviation from the long run equilibrium (Enders 2004. p 328-329). As the model in Section 5 is concerned with the number of filed and actual foreclosure in equilibrium, such a representation is fortunate. The ECM allows for estimation of both the long run equilibrium condition and the impact of short run changes in the variables.

To see how the ECM can be derived, let the ARDL model in (17) form the starting point. Now, by adding and subtracting y_{t-1} and $b_0 x_{t-1}$, the equation can be rewritten in the following way

$$\Delta y_t = a_0 + b_0 \Delta x_t - (1 - a_1)y_{t-1} + (b_0 + b_1)x_{t-1} + e_t \quad (19)$$

$$\Delta y_t = a_0 + \lambda(y_{t-1} - \beta_1 x_{t-1}) + b_0 \Delta x_t + e_t \quad (20)$$

Where $\beta_1 = \frac{(b_0+b_1)}{1-a_1}$ $\lambda = -(1 - a_1)$.

The term $y_t - \beta_0 - \beta_1 x_t = u_t$ is the cointegrated relationship which by definition is stationary. Define the system's "steady state" by setting $y^* = y_t = y_{t-1}$ and $x^* = x_t = x_{t-1}$. Then the ECM may be re-expressed in the following way

$$\Delta y_t = \mu + \lambda(y_{t-1} - y^*) + b_0 \Delta x_t + e_t \quad (21)$$

With $\mu = a_0 + \lambda\beta_0$ and $y^* = \beta_0 + \beta_1 x^*$

Now, we see that the parameter λ , called the speed of adjustment parameter, denotes how Δy_t is affected by disequilibrium constellations. If the system is temporary above its long run equilibrium, so that $y_{t-1} > y^*$, λ will bring the variable towards equilibrium by lowering Δy_t . Consequently, in order for the system to return to equilibrium, $\lambda < 0$. Note that if the system did not return to equilibrium, there would be no cointegrating relationship, as the variables could wander arbitrarily far from each other. The Engle-Granger representation theorem states that the restrictions necessary to ensure that the variables are $CI(1, 1)$ guarantee that an equilibrium-correction model exists. Thus cointegration implies equilibrium correction, and equilibrium correction implies cointegration

Testing for non-stationarity

In the previous section, I described the importance of determining whether a variable is stationary or not. In order to test whether the variables in the data set are stationary, I use the Im-Pesaran-Shin (IPS) test for panel unit roots. The test regression is specified as follows:

$$\Delta y_{it} = a_{i0} + \gamma_i y_{i,t-1} + \sum_{j=1}^{p_i} \delta_{ij} \Delta y_{i,t-j} + \varepsilon_{it}, \quad \text{where } \begin{matrix} i = 1, \dots, N \\ t = 1, \dots, T \end{matrix} \quad (22)$$

The test parameter γ_i is used to test the null hypothesis that all cross-sections contains a unit root against the alternative hypothesis that some cross-sections are stationary:

$$H_0 : \quad \gamma_1 = \gamma_2 = \gamma_3 \dots = \gamma_N = 0$$

$H_1 : \quad \gamma_i < 0 \text{ for at least one } i$ ²⁹

Estimating (22) for $i = 1, \dots, N$ an average t-statistic $\bar{t} = (1/n) \sum_{i=1}^n t_i$ may be calculated. This test statistic is used to test the null hypothesis of non-stationarity against the alternative that the variable for at least one of units in the panel is stationary. Since, the null hypothesis of the test is that the series contain a unit root, the t-bar cannot be evaluated against critical values from the standard t-distribution. This is because under the null of non-stationarity, the test statistics follows a non-standard distribution. Instead, the t-bar is evaluated against Im-Pesaran-Shins (2003) finite sample critical values. The advantage of this test is that it allows for heterogeneity in the unit root parameter γ_i .

For the test to be valid, the error terms must be serially uncorrelated and contemporaneously uncorrelated. However, the different regions are likely to be affected by common shocks, so that the residuals from the equation in each panel may be contemporaneously correlated, i.e. $E(\varepsilon_{it}, \varepsilon_{jt}) \neq 0$. In order to alleviate this problem, a common time effect is subtracted from each observation $\bar{y}_t = (1/n) \sum_{i=1}^n y_{it}$.³⁰ Another drawback of the IPS-test is that the alternative hypothesis is that at least on unit in the panel is stationary. Hence in some regions $y_{it} \sim I(1)$ while others are $I(0)$. A rejection of the null hypothesis is thus possible even though several of the panels contains a unit root. To accommodate this problem, I also include the Breitung test for panel unit roots.

This test assumes a common autoregressive parameter for each panel. The test has the null hypothesis of all panels containing a unit root against the alternative hypothesis that all panels are stationary. The test uses the augmented Dikey-Fuller (ADF) test regression as a starting point for each cross-sectional unit in the panel.³¹

$$\Delta y_{it} = \rho y_{i,t-1} + \sum_{j=1}^{p_i} \delta_j \Delta y_{i,t-j} + \varepsilon_{it} \quad (23)$$

Two auxiliary regressions are performed:

1. Δy_{it} on Δy_{it-L} and obtain the residuals $\hat{\varepsilon}_{it}$

²⁹A unit root exist if $a_1 = 1$ in the equation $y_t = a_1 y_{t-1} + \epsilon_t$. This equation can be written as $\Delta y_t = \gamma y_{t-1} + \epsilon_t$ where $\gamma = a_1 - 1$. Hence, testing whether $a_1 = 1$ is equivalent to testing the null hypothesis $\gamma = 0$

³⁰Unfortunately, this correction may not eliminate the entire correlation and moreover, it is possible that \bar{y}_t is non-stationary (Enders 228)

³¹See Breitung and Das (2005)

2. y_{it-1} on Δy_{it-L} to get the residuals $\widehat{v}_{i,t-1}$

Then a forward orthogonalization transformation is applied to the residuals $\widehat{\varepsilon}_{it}$ to obtain e_{it}^* . Finally, a pooled regression $e_{it}^* = \rho v_{it-1}^* + u_{it}^*$ is estimated, which asymptotically follows a standard normal distribution. The parameter ρ is used to test the null hypothesis that all cross-sections contain a unit root against the alternative hypothesis that all variables are stationary: ³²

$$H_0 : \quad \rho = 0$$

$$H_1 : \quad \rho < 0$$

The tests for panel unit root is performed on the variables both in levels and changes in order to evaluate their order of integration.

Testing for cointegration

After having determined the variables' order of integration, it is possible to test whether the variables with the same order of integration are cointegrated. A simple two-step test can be performed to see whether a set of variables have a cointegrating relationship (Engle and Granger 1987), i.e. that they share a common stochastic trend. Consider the following equation:

$$y_{it} = \beta_1 x_{it} + u_{it} \tag{24}$$

where $x_{it}, y_{it} \sim I(0)$. Then for y_{it} and x_{it} to be cointegrated, u_{it} must be $I(0)$. The two step test can be described in the following way:

1. From an OLS regression on (24), obtain the estimates of the errors $\widehat{u}_{it} = y_{it} - \widehat{\beta}_1 x_{it}$.
2. Test whether \widehat{u}_{it} contains a unit root by using a panel unit root test. If the null hypothesis of a unit root is rejected, we conclude that y_{it} and x_{it} are cointegrated.

Finally, it is possible to test whether the specified model actually corrects towards a long run equilibrium. Since equilibrium correction implies cointegration, this can be used as additional evidence supporting or rejecting cointegration. For y_{it} and x_{it} to be cointegrating, we know from the E-G representation theorem that the parameter λ in

³²The test statistics used in this thesis allows for cross-sectional correlation among the error-terms (Source http://homepage.univie.ac.at/robert.kunst/pan2011-pres_nell.pdf, Breitung and Das 2005).

equation (25) must be significantly negative. Note, however, that the estimate of λ does not follow a t-distribution since under the null of no cointegration, $y_{it} - \beta_0 - \beta_1 x_{it}$ is $I(1)$.

$$\Delta y_{it} = a_0 + \lambda(y_{i,t-1} - \beta_0 - \beta_1 x_{i,t-1}) + b_0 \Delta x_{it} + e_{it} \quad (25)$$

The application of cointegration test on a panel of cross-section has the advantage of increasing the statistical power of the test. In addition, the panel structure allows for more variability and efficiency than examining each cross-sectional unit separately (Levin, Lin and Chu 2002). However, the panel structure also imposes additional complications. First, the cross-sectional unit may not be contemporaneously uncorrelated. Second, the cointegrating relationship may be cross-section specific, so that assuming homogenous cointegration becomes misleading (Breitung and Pesaran 2005). Consider the following regression equation where α_i denotes region fixed effects:

$$y_{it} = \alpha_i + \beta_{1i} x_{it} + u_{it} \quad (26)$$

$$x_{it} = \mu + x_{i,t-1} + v_{it} \quad (27)$$

$$u_{it} = \rho_i u_{i,t-1} + e_{it} \quad (28)$$

Now if $\rho_i < 1$ for all i , errors are stationary and cointegration is implied. If $\beta_{1i} = \beta_1$ the cointegrating relationship is homogenous across regions and the results are valid from panel cointegration. However, if there is heterogeneous cointegration, but we impose homogeneity, the composite error term will in general not be stationary. Consider the following model:

$$y_{it} = \alpha_i + \beta_1 x_{it} + [(\beta_{1i} - \beta_1) x_{i,t} + e_{it}] \quad (29)$$

The term in brackets shows the composite error from the regression. While e_{it} is stationary, the term $(\beta_i - \beta_1)x_{i,t}$ may be non-stationary. In order to test whether the results are robust to panel heterogeneity, I use a simplified version of the Pesaran, Shin and Smith (1999) model. The model accounts for heterogeneity across the regions by allowing the speed of adjustment parameter α_i to differ across regions while a common long-run relationship (β_i is common for all regions) is imposed between the variables. Eberhardt (2011) argues that the estimators is appealing when studying small sets of arguably "similar" countries rather than large diverse macro panels. The estimation is specified in the following way:

$$\Delta y_{it} = a_0 + \lambda_i(y_{i,t-1} - \hat{\beta}_1 x_{i,t-1}) + b_0 \Delta x_{it} + e_{it} \quad (30)$$

Estimating the ECM:

In order to estimate the equilibrium correction model a simple two-step procedure following Engle and Granger (1987) are performed.

1. Run a regression of y_{it} on x_{it} and save the residuals $\hat{u}_{i,t} = y_{it} - \hat{\beta}_1 x_{it}$
2. Run error-correction regression of Δy_{it} on the estimated residuals $\hat{u}_{i,t}$ and on Δx_{it}

$$\Delta y_{it} = a_0 + \lambda \hat{u}_{i,t-1} + b_0 \Delta x_{it} + e_{it} \quad (31)$$

Finally, in order to remove the unobserved fixed effects (that may be correlated with the dependent variables), the variables in the regression are time-demeaned ³³

$$\Delta \tilde{y}_{it} = \lambda \hat{u}_{i,t-1} + b_0 \Delta \tilde{x}_{it} + \tilde{e}_{it} \quad (32)$$

³³Applying a fixed effects panel estimation, the time mean for each cross-sectional unit is subtracted on both sides on the equation so that the region fixed effects are controlled for

$$\tilde{y}_{it} = y_{it} - \frac{1}{T} \sum_{i=0}^T y_{it}$$

The time demeaning is applied both to the cointegrating relationship and the ECM. Note that this procedure only removes time-invariant fixed effects that may be correlated with the regressors. If there are region specific effects that are not constant over time and correlated with both the independent variables and the regressors, there would still be a problem of omitted variable bias.

7 Econometric results

This section seeks to empirically test the hypotheses of the previous sections:

1. To what extent is the recent increase in filed foreclosures driven by the increase in debt burden of Norwegian households?
2. Why are so few filed foreclosures materialized as actual foreclosures? Can this be attributed to recent years housing price growth?

In order to answer these questions, I specify an empirical model for filed and actual foreclosures on the panel data set gathered for this thesis. Due to evidence of non-stationarity in filed and actual foreclosures, I test for cointegration before I develop dynamic models to investigate the short run determinants of these variables.

7.1 Testing for unit root

To test the order of integration of the variables included in the analysis, I make use of both the IPS-test and the Breitung test. The tests are conducted for the variables both in levels and in first differences. For the levels, I include a constant and a deterministic trend in the test regressions. Consistent with this, only a constant is included when testing the variables in first differences. Results are reported in Table 2 and Table 3.

The IPS-test shows that we cannot reject the null hypothesis that the variables are non-stationary, except for the case of the log of housing prices. For housing prices, the IPS-test rejects that all cross-sectional units contain a unit root at a five percent significance level. However, even if some cross-sectional units are stationary, it does not ensure that housing prices are stationary, as several panels may contain a unit root. The Breitung-test strongly indicates that housing prices contain a unit root, which is consistent with the existing empirical literature on housing prices (Anundsen and Jansen, 2011). When looking at the variables in first differences, however, both tests reject the null hypothesis of a unit root for all variables. Thus, it is assumed that all variables in this data-set are integrated of order one, though there are some minor signs of $I(2)$ in household debt.

Panel unit root test - IPS: 1995-2010

Variable	<i>Levels</i>		<i>First differences</i>		
	Statistic	p-values	Statistic		p-values
d	2.31	0.98	-1.15		0.12
i	1.75	0.96	-5.37	***	0.00
DTI	0.85	0.80	-4.21	**	0.00
hprice	-1.99	**	-3.60	***	0.00
unemp	-0.74	0.21	-4.03	***	0.00
ff	-0.03	0.48	-5.06	***	0.00
af	-1.15	0.12	-8.59	***	0.00
H_0 :	All panels contain unit root				
H_1 :	Some panels are stationary				

Table 2: IPS-test

The IPS test allows for heterogeneity in the autoregressive coefficients and uses one lag for each variable. The lag length chosen is the same as in the Breitung test in order for the tests to be comparable. The Breitung test requires more time periods net of lags than cross-sectional units. This limits the lag length to one in the Breitung test. When testing in levels, a trend and a constant is included. For the first differences only a constant term is included in order for consistency. Lower case letters indicate logs see Table 4 for a description of the variables. *, **, *** dentotes the 1,5,10 percent significant level respectively

Panel unit root test - Breitung: 1995-2010

Variable	<i>Levels</i>		<i>First differences</i>		
	Statistic	p-values	Statistic		p-values
d	0.64	0.74	-1.59	**	0.06
i	0.91	0.82	-2.75	***	0.00
DTI	-0.45	0.32	-2.45	***	0.01
hprice	-0.28	0.39	-2.79	***	0.00
unemp	-0.58	0.22	-2.24	**	0.04
ff	-0.57	0.28	-3.73	***	0.00
af	-0.49	0.69	-4.63	***	0.00
H_0 :	All panels contain unit root				
H_1 :	Some panels are stationary				

Table 3: Breitung-test

The Breitung test uses one lag for each variable in order control for autocorrelation in the error-term. The robust version of the Breitung test requires more time periods net of lags than cross-sectional units. This limits the lag length to one. Furthermore a deterministic trend and a constant is included. For the first differences, only a constant term is included. The test-statistic is robust to cross-sectional correlation in the error-term (Breitung 2005). All lower case letters indicate logs see Table 4. *, **, *** dentotes the 1,5,10 percent significant level respectively

List of symbols

Variable	Symbol	Description
Actual foreclosures	af	The regional number of actual foreclosures per 1000 capita in logs
Debt	d	The level of average real household debt within in a region measured in logs
Debt-to-income	DTI	The debt to income ratio: $\log(\text{debt}) - \log(\text{income})$
Filed foreclosures	ff	The regional number of filed foreclosures per capita in logs
Housing price	hprice	The regional housing price (kroner per m^2) for an average house of 100 m^2 measured in logs adjusted for inflation
Income	i	The level of average real household income within a region measured in logs
Interest rate	R	Banks average lending rate
Unemployment	unemp	The regional unemployment rate measured in logs

Table 4: List of symbols

7.2 Estimating filed foreclosures

Cointegrating relationship

The number of filed foreclosures is assumed to be determined by (12) in Section 5 . Hence, the number filed foreclosures is modeled as a function of housing prices, households' debt-to-income ratio (DTI-ratio), unemployment and the banks average interest rate on loans. A semi logarithmic representation is:³⁴

$$ff_{it} = \beta_0 + \beta_1 DTI_{it} + \beta_2 hprice_{it} + \beta_3 unemp_{it} + u_{it} \quad (33)$$

³⁴Household income, household debt and housing prices are strongly correlated as Table 5 suggests. Consequently the following auxilliary regression is performed:

$$hprice_{it} = \theta_1 DTI_{it} + e_{it}$$

Then an estimate of the housing prices "cleaned" for the effect of debt is calculated as:

$$\hat{hprice}_{it} = hprice_{it} - \hat{\theta}_1 DTI_{it}$$

Correlation matrix

Variable	debt	income	hprice
d	1.000		
i	0.945	1.000	
hprice	0.936	0.923	1.000

Table 5: Correlation matrix

Table (6) presents results for the hypothesized cointegrating relationship for filed foreclosures. The estimates on the DTI ratio and the unemployment rate are significant and come with their expected signs. A one percentage point increase in the household DTI ratio is found to increase the number of filed foreclosures by almost 1.5 percent, while a one percent increase in the unemployment rate increases the number of filed foreclosure by 0.14 percent. The estimated effect of the DTI-ratio is comparable to that of Aron and Muellbauer (2010), who find that a one percent increase in the debt-service-ratio increases the number of mortgage arrears with 1.6 percent.³⁵

However the estimate on the unemployment rate is surprisingly low compared to Aron and Muellbauer (2010). The authors find that a one percent increase in the unemployment rate increases the number of arrears by 0.8 percent using the log of the unemployment rate. In contrast, I find that a one percent increase in the unemployment rate increases the number of filed foreclosures by 0.14 percent. A possible reason for the relatively low estimate may be the higher unemployment benefit in Norway compared to the UK.³⁶ Yet, the estimate is not "too" low to have economic implications. An increase in unemployment from 2 to 4 percent, would lead to a 14 percent increase in the number of filed foreclosures, according to my estimate.

The estimated effect of on housing prices is not significant whether it is adjusted for common correlation or not. That said, the signs of the estimates are consistent with predictions of the model in Section 5.

Both the Breitung test and the IPS-test rejects a panel unit root at the five percent significant level, suggesting that there is evidence that a cointegrating relationship exists.³⁷

Short run dynamics

Since both tests indicate cointegration, I proceed to estimate filed foreclosures in an ECM setup. This model is based on the cointegrating relationship in Table 5:

$$ecm_{it}^{filed} = f f_{it} - \beta_0 - \beta_1 DTI_{it} - \beta_2 unemp_{it} \quad (34)$$

³⁵Aron and Muellbauer (2010) defines the debt-service ratio as the product of the mortgage interest rate and the level of debt divided by disposable income

³⁶Measured as the gross replacement rate the UK has a much lower unemployment insurance than in Norway. However, the accuracy of this indicator can be debated (Howell and Rehm 2009)

³⁷That is, when excluding housing prices from the cointegrating relationship

Filed foreclosures 1995-2010
Cointegrating relationship

Variable	Estimate	Sd.		Estimate	Sd.	
<i>DTI</i>	1.490	0.13	***	1.443	0.13	***
<i>unemp</i>	0.145	0.05	**	0.098	0.043	**
\widehat{hprice}	0.196	0.18				
F-test	45.75			65.62		
R-squared within	0.65			0.64		
Number of observations	224			224		
Number of regions	14			14		
Number of years	16			16		
Test for stationarity in the error-correction term:						
IPS	-1.24			-2.81		***
Breitung	-1.79		**	-1.77		**

Table 6: Cointegration filed foreclosures

All variables are time-demeaned and the variables in lower case are in logs see Table 4. The standard errors in the regression is clustered by region to account for any serial correlation. The tests for stationarity include trend and are robust for cross-sectional correlation. *, **, *** denotes the 1,5,10 percent significant level respectively. In order to limit multicollinearity I use the households debt to income ratio ($\log(debt_{it}) - \log(income_{it})$) in addition to the other variables. Furthermore, an auxiliary regression is performed on housing prices in order to remove the common correlation shared with the DTI-ratio

Filed foreclosures 1995-2010

Equilibrium correction model

Variable	Estimate	Sd.		Estimate	Sd.	
$ecm_{i,t-1}^{filed}$	-0.379	0.04	***	-0.319	0.053	***
$\Delta f f_{it-1}$	0.100	0.101				
$\Delta DTI_{i,t}$	0.532	0.201	**	0.582	0.175	***
$\Delta DTI_{i,t-1}$	-0.152	0.334				
$\Delta hprice_{i,t}$	-0.362	0.138	**	-0.446	0.127	***
$\Delta hprice_{i,t-1}$	-0.115	0.224				
$\Delta unemp_{i,t}$	0.144	0.038	***	0.197	0.034	***
$\Delta unemp_{i,t-1}$	0.079	0.06				
ΔR_t	0.027	0.008	***	0.021	0.07	**
ΔR_{t-1}	0.019	0.006	**	0.011	0.005	**
F-value	1626.22			28.03		
R-squared within	0.31			0.29		
Number of observations	196			196		
Number of regions	14			14		
Number of years	14			14		
Normality JB	2.98**			3.07**		
Autocorrelation	0.23			0.24		

Table 7: ECM Filed foreclosures

This model is based on the cointegrating relationship in Table 5:

$ecm_{it}^{filed} = lfiled_{it} - \beta_0 - \beta_1 DTI_{it} - \beta_2 unemployment_{it}$. All variables are time-demeaned and the variables in lower case are in logs see Table 4. The Jarque-Bera normality test and Wooldridge (2002) test for autocorrelation are included. The Wooldridge test reports the p-value of the hypothesis of no first order autocorrelation. The standard errors in the regression is clustered by region to account for serial correlation. The left column with results refers to the general model, whereas the right column refers to the specific model, going from general to specific by excluding the most insignificant variable in each step. A dummy variable for 2004 and 2005 are included in the general specification of the model due to the interpolation of the dataseries. Δ denotes that the variable is first differenced.

*, **, *** denotes the 1,5,10 percent significant level respectively. In order to limit multicollinearity, I use the households debt to income ratio ($\log(debt_{it}) - \log(income_{it})$) in addition to the other variables.

$$\Delta f f_{it} = \beta_0 + \beta_1 \Delta f f_{i,t-1} + \sum_{j=0}^1 \delta_j \Delta \mathbf{x}_{i,t-j} + \lambda(ecm_{i,t-1}^{filed}) + u_{it} \quad (35)$$

Here, \mathbf{x}_{it} is a vector of [$unemp_{it}$ DTI_{it} $hprice_{it}$ R_{it}].

In Table (7), the results from the ECM estimation are presented. I proceed by going from a general model to a specific model by stepwise removing the most insignificant variable untill only significant variables are retained. Note first that the negative, highly significant estimate on the adjustment coefficient λ gives additional support for cointegration by strongly indicating that an equilibrium correction mechanism exists (Engle

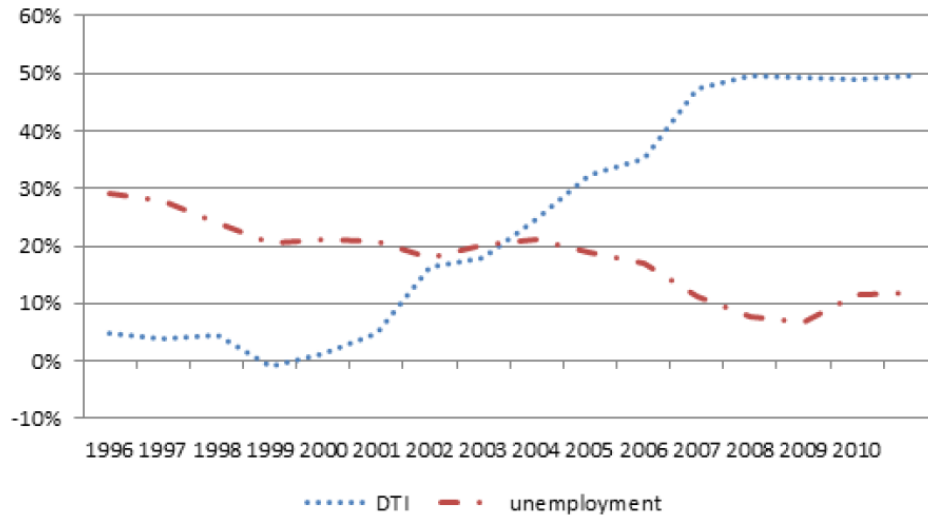
and Granger 1987). We see that all variables come with their expected signs. The contemporaneous effect of an increase in the DTI-ratio of one percentage point, increases the number of filed foreclosures by about 0.5 percent. Thus, both in the short run, and in the long run, increases in the DTI-ratio is found to increase the number of filed foreclosures. The short run estimates on housing prices shows a negative connection between housing prices and filed foreclosures. This is consistent with the findings of Aron and Muellbauer (2010), who find that an increase in the proportion of households with negative equity increases the number of mortgage arrears by 0.1 percent.

The estimate for housing prices is interesting. It might indicate that households are able to borrow against their house prior to receiving a filed foreclosure. However, it might also be that a higher level of housing prices increases the households willingness to keep the house and consequently the willingness to pay their contracted mortgage installments. Finally, the negative impact of short run changes in unemployment and the interest rate is consistent with the conjectures of the theoretical model of Section 5.

Estimated long run contributions

In sum, the evidence presented above is clearly consistent with the notion that the recent increase in filed foreclosures are driven by the growth in household debt. Both interest rates and the unemployment rate have remained low the last years and housing prices have increased. Thus it seems that the growth in household debt is the main factor behind the increase in filed foreclosures. This is illustrated in Figure 14, which plots the estimated long run contribution of the DTI-ratio and the unemployment rate as a percentage of the level of filed foreclosures. From the figure, we see that the impact of the DTI-ratio on filed foreclosures has increased substantially the last decade.

Figure 14: Estimated long run contributions of DTI-ratio and the unemployment rate



The figure plots the contribution of the DTI-ratio and the log unemployment rate in explaining the level of log filed foreclosures per capita. The contribution of each variable is measured in percent of the log of filed foreclosures per capita.

7.3 Estimating actual foreclosures

Based on the discussion in Section 5, it is expected that the number of actual foreclosures could be seen as the number of filed foreclosures that is not refinanced by the bank (or voluntarily sold by the household). The data gathered for this thesis does not allow me to observe the number of households that get a refinancing deal. However, the variables influencing this decision are observed. The relationship in equation (15) shows that the number of filed foreclosures ending in a refinancing deal depends positively on housing prices and negatively on household debt. Consequently, we would expect that the number of actual foreclosures increases with household debt and decreases with housing prices as fewer filed foreclosures ends in refinancing. Based on the presented model, the following cointegrating relationship is hypothesized:

$$af_{it} = \beta_0 + \beta_1 ff_{it} + \beta_2 d_{it} + \beta_3 hprice_{it} + u_{it} \quad (36)$$

Table 8 presents the results obtained when estimating (36). We see that all variables are significant and comes with their expected signs. A one percent increase in the number of filed foreclosures is estimated to increase the number of actual foreclosures by 0.5 percent. Hence, absent any refinancing, my results indicate that as much as 50 percent

Actual foreclosures 1995-2010

Cointegrating relationship

Variable	Estimate	Sd.		Estimate	Sd.	
ff	0.549	0.173	***	0.398	0.198	**
d	-0.734	0.186	***	-0.364	0.262	
\widehat{hprice}	-2.459	0.552	***	-1.732	0.649	**
$unemp$				-0.595	0.119	***
F-value	11.89			11.89		
R-squared within	0.34			0.34		
Number of observations	224			224		
Number of regions	14			14		
Number of years	16			16		
Test for stationarity in the error-correction term:						
IPS	-2.81		***	-2.86		***
Breitungg	-2.74		***	-3.10		***

Table 8: Cointegration actual foreclosures

All variables are time-demeaned and the variables in lower case are in logs see Table 4. In order to limit multicollinearity between household debt and housing prices, housing prices are "cleaned" for debt in the following way: $\widehat{hprice}_{it} = hprice_{it} - \widehat{\beta}_1 debt_{it}$, where $\widehat{\beta}$ is estimated from a fixed effects regression of debt on housing prices. The standard errors in the regression is clustered by region to account for serial correlation. The tests for stationarity include trend and are robust for cross-sectional correlation. *, **, *** denotes the 1, 5, 10 percent significant level, respectively

of the number of filed foreclosures would end up in an actual foreclosure. However, the results also suggest that a one percent increase in housing prices reduces the number of actual foreclosures by 2.5 percent in the long run. This clearly demonstrates that the growth in housing prices over the last decade have kept the number of actual foreclosures down. Finally, we see that a one percent increase in household debt lowers the number of actual foreclosures with 0.73 percent. However, the estimate on debt is not significant when including the unemployment rate in the specification. Thus, the data cannot be seen to firmly support a long term impact of debt on the number of actual foreclosures.

The results are not directly comparable with that of Aron and Muellbauer (2011) as they estimate the rate of foreclosures (repossession) per mortgage outstanding. The authors find that an increase in the debt-service ratio has a significant negative impact on the possession rate, and the same for the estimated proportion of household experiencing negative equity. Hence, the direction of the mechanisms in this thesis are consistent with the findings of Aron and Muellbauer (2011)

Note that both Aron and Muellbauer (2011) and Astrup and Holm (2009) find a strong

effect of unemployment on the number of foreclosures. I find that a one percent increase in the unemployment rate increases the number of actual foreclosures by 0.5 percent. Furthermore, when unemployment is included in the analysis, the long run estimate on housing prices is lowered to -1.7 percent and the long run estimate on filed foreclosures is lowered to about 0.4 percent.

The tests for a unit root in the error term is firmly rejected at a one percent significance level, suggesting that there is a cointegrating relationship between the variables.

Short run dynamics

The following ECM is estimated for actual foreclosures:

$$\Delta af_{it} = \beta_0 + \beta_1 \Delta af_{it-1} + \sum_{j=0}^2 \delta_j \Delta \mathbf{y}_{it-j} + \lambda(ecm_{i,t-1}^{forec}) + u_{it} \quad (37)$$

Here af_{it} is the log of the number of foreclosures per capita and \mathbf{y} is a vector of $[unemp_{it} \ d_{it} \ hprice_{it} \ R_{it}]$. The equilibrium term in (38) reflects departures from the long run cointegrating relationship in Table 7. Since the process from default to foreclosure may take as long as 12 month, I have included two lags of each variable

$$ecm_{it}^{forec} = af_{it} - \hat{\beta}_0 - \hat{\beta}_1 f_{it} - \hat{\beta}_2 d_{it} - \hat{\beta}_3 hprice_{it} - \hat{\beta}_4 unemp_{it} \quad (38)$$

From Table 8, we see that the equilibrium correction term is significantly negative, which gives additional support for the existence of a cointegrated relationship. The estimate suggest a rapid adjustment to equilibrium, where more than 70 percent of a 1 percent deviation from equilibrium is adjusted within a year.

Moving from a general, to a specific model, we see that the short run effects are in line with the long run estimates. A one percent increase in the numbers of filed foreclosures increases the number of actual foreclosures by about 0.2 percent in the short run. Yet, this estimate is somewhat uncertain as it is only significant at the 10 percent level. A one percent increase in housing prices lowers the numbers of actual foreclosures by more than 0.75 percent in the short run while, a one percent increase in household debt increases the number of actual foreclosures by 2.7 percent. Finally, we see that the short run impact of unemployment and the interest rate are significant and come with their expected signs.

Actual foreclosures 1995-2010

Equilibrium correction model

Variable	Estimate	Sd.		Estimate	Sd.	
$ecm_{i,t-1}^{forec}$	-0.736	0.139	***	-0.741	0.08	***
$\Delta af_{i,t-1}$	-0.06	0.063				
Δff_{it}	0.205	0.156	**	0.206	0.115	*
$\Delta ff_{i,t-1}$	0.072	0.114				
$\Delta ff_{i,t-2}$	-0.074	0.225				
$\Delta hprice_{it}$	-0.667	0.701		-0.774	0.361	**
$\Delta hprice_{i,t-1}$	0.352	0.582				
$\Delta hprice_{i,t-2}$	0.006	0.509				
Δd_{it}	-0.436	1.858				
$\Delta d_{i,t-1}$	2.319	1.501		2.726	1.141	**
$\Delta d_{i,t-2}$	1.293	1.607				
$\Delta unemp_{it}$	0.304	0.133	**	0.269	0.116	**
$\Delta unemp_{i,t-1}$	0.782	0.180	***	0.724	0.137	***
$\Delta unemp_{i,t-2}$	-0.528	0.219	**	-0.609	0.159	***
ΔR_t	0.038	0.023				
ΔR_{t-1}	-0.009	0.042		0.046	0.016	**
ΔR_{t-2}	-0.002	0.032				
F-value	93.65			23.75		
R-squared within	0.53			0.52		
Number of observations	196			196		
Number of regions	14			14		
Number of years	14			14		
Normality JB	9.72			10.32		
Autocorrelation	0.81			0.32		

Table 9: ECM Actual foreclosures

This model is based on the cointegrating relationship on the right hand sign in Table 7:

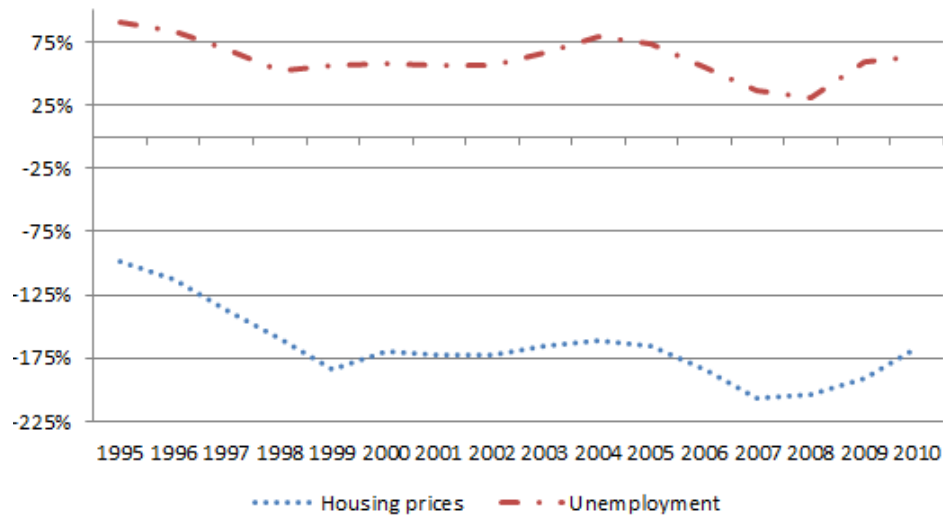
$ecm_{it}^{forec} = af_{it} - \hat{\beta}_0 - \hat{\beta}_1 ff_{it} - \hat{\beta}_2 d_{it} - \hat{\beta}_3 hprice_{it} - \hat{\beta}_4 unemp_{it}$. All variables are time-demeaned and the variables in lower case are in logs see Table 4. The Jarque-Bera normality test and Wooldridge (2002) test for autocorrelation are included. The Wooldridge test reports the p-value from testing the hypothesis of no first order autocorrelation. The standard errors in the regression are clustered by region to account for serial correlation. The left column with results refers to the general model, whereas the right column refers to the specific model, going from general-to-specific by excluding the most insignificant variable in each step. A dummy variable for 2004 and 2005 are included in the general specification of the model due to the interpolation of the dataseries. Δ denotes that the variable is first differenced. *, **, *** dentotes the 1,5,10 percent significant level respectively

Estimated long run contributions

Taken together, I argue that the estimation results give a plausible indication of the main determinants behind the development in actual foreclosures. During the last five years, the numbers of filed foreclosures has increased, while the number of actual foreclosures

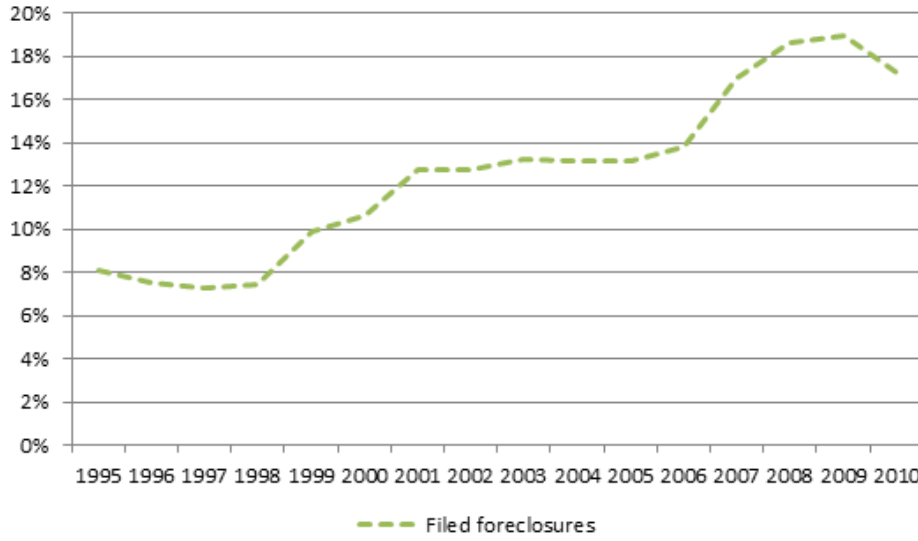
has been relatively stable. The estimation results clearly suggest that the increase in housing prices over the last decade has kept the number of actual foreclosures low despite the increase in filed foreclosures. The long run contribution of housing prices, the unemployment rate and filed foreclosures are illustrated in Figure 15 and Figure 16. From the figures, we see that the recent increase in filed foreclosures, *ceteris paribus*, points to an increase in actual foreclosures as well. However, during most part of the decade, the development in housing prices appears to have lowered the number of actual foreclosures. This suggests that macroeconomic development, not only affects the numbers of filed foreclosures, but also has a substantial impact on the number actual foreclosures.

Figure 15: Estimated long run contributions of housing prices and the unemployment rate



The figure plots the contribution of the log of housing prices and the log unemployment rate in explaining the level of log actual foreclosures per capita. The contribution of each variable is measured in percent of the log of foreclosure per capita.

Figure 16: Estimated long run contributions of filed foreclosures



The figure plots the contribution of the log of filed foreclosures in explaining the level of log actual foreclosures per capita. The contribution is measured in percent of the log of foreclosures per capita.

7.4 Adjusting for panel heterogeneity

In order to see whether the results are robust to possible panel heterogeneity, I estimate the ec-model with a regional adjustment parameter for filed and actual foreclosures, as specified in (30). This addition, I argue, has two main benefits. First, by conducting the heterogeneous estimation, we can assess to what extent the "pooled" short run dynamics from the previous sections are valid. Furthermore, this addition provides estimates on the regional speed of adjustment, which may reveal systematic regional differences in hpw deviations from the estimated equilibrium are adjusted. Systematic regional differences in the adjustment coefficient could be related to the variables included in the dataset. For instance, in regions with high levels of housing prices, a slower adjustment for actual foreclosures could be interpreted as the banks' being less impatient in covering their losses. Yet, such differences could also be related to different capacities among the regional courts.

Table 10 reports the heterogeneous estimation of the number of filed foreclosures. We see that the short run coefficients are almost identical with those reported in Table 6. That said, when looking at Table 11, we see that the short run coefficient on household debt is no longer significant. The adjustment coefficient in the table reveals both substantial variation, and also a very rapid adjustment to equilibrium for a number of regions. That

Heterogenous ECM: Filed foreclosures 1995-2010

Variable	Estimate	Sd.	
$\Delta DTI_{i,t}$	0.531	0.201	**
$\Delta hprice_{i,t}$	-0.484	0.126	***
$\Delta unemp_{i,t}$	0.203	0.037	***
ΔR_t	0.021	0.008	**
ΔR_{t-1}	0.099	0.005	**
Regional adjustment parameter			
Østfold	-0.218	0.03	***
Akershus	-0.176	0.04	***
Oslo	-0.227	0.04	***
Hedmark	-0.285	0.03	***
Oppland	-0.424	0.03	***
Buskerud	-0.625	0.05	***
Vestfold	-0.254	0.09	**
Telemark	-0.487	0.02	***
Agderfylkene	-0.311	0.03	***
Rogaland	-0.183	0.03	***
Hordaland	-0.308	0.04	***
Møre- og Romsdal	-0.936	0.04	***
Trøndelagsfylkene	-0.379	0.03	***
Nord-Norge	-0.278	0.03	***
R-squared within		0.32	
Number of observations		210	
Number of regions		14	
Number of years		15	

Table 10: Heterogenous ECM filed foreclosures

The estimation uses the specific ECM-model from Table 6. In order to obtain the regional adjustment parameter, a regional dummy has been multiplied with the estimated cointegrating relationship. All variables are time-demeaned and the variables in lower case are in logs see Table 4. The standard errors in the regression is clustered by region to account for serial correlation. Δ denotes that the variable is first differenced. *, **, *** denotes the 1,5,10 percent significant level respectively

Heterogenous ECM: Actual foreclosures 1995-201

Variable	Estimate	Sd.	
$\Delta hprice_{it}$	-0.685	0.365	*
$\Delta d_{i,t-1}$	1.850	1.285	
$\Delta unemp_{it}$	0.212	0.128	
$\Delta unemp_{i,t-1}$	0.699	0.138	***
$\Delta unemp_{i,t-1}$	-0.554	0.163	***
$\Delta R_{i,t-1}$	0.043	0.017	**
Regional adjustment parameter			
Østfold	-0.998	0.04	***
Akershus	-0.314	0.04	***
Oslo	-1.314	0.06	***
Hedmark	-1.536	0.18	***
Oppland	-0.939	0.08	***
Buskerud	-0.378	0.07	***
Vestfold	-0.723	0.04	***
Telemark	-1.063	0.06	***
Agderfylkene	-0.823	0.05	***
Rogaland	-0.411	0.04	***
Hordaland	-1.273	0.07	***
Møre- og Romsdal	-0.371	0.04	***
Trøndelagsfylkene	-0.468	0.08	***
Nord-Norge	-0.633	0.100	***
R-squared within		0.50	
Number of observations		210	
Number of regions		14	
Number of years		15	

Table 11: Heterogenous ECM

The estimation uses the specific ECM-model from Table 8. In order to obtain the regional adjustment parameter, a regional dummy has been multiplied with the estimated cointegrating relationship. All variables are time-demeaned and the variables in lower case are in logs see Table 4. The standard errors in the regression is clustered by region to account for serial correlation. Δ denotes that the variable is first differenced. *, **, *** denotes the 1, 5, 10 percent significant level respectively

is, in some of the regions almost all disequilibrium is corrected within a year.

Figure 17 and 18 show how the speed of adjustment varies across the different regions. I have not been able to detect any systematic differences in these estimates. Neither does there seem to be a connection between the regional distribution of the speed of adjustment for filed foreclosures and that of actual foreclosures. A further point of research could be to explore the regional heterogeneity in more detail. Within the time constraint given for this thesis, this was not possible.

Figure 17: Regional speed of adjustment, filed foreclosures

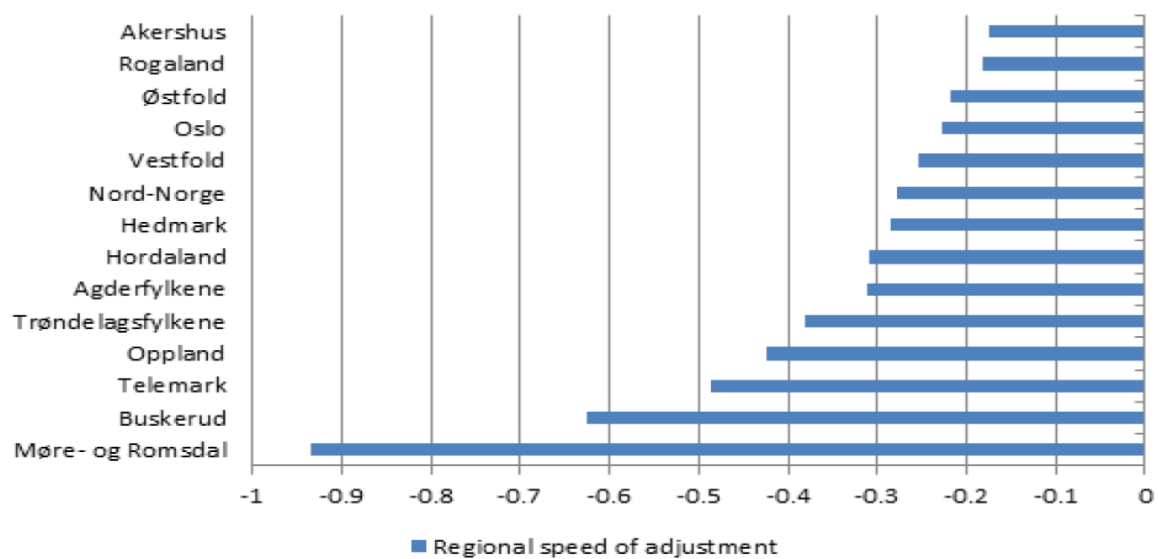
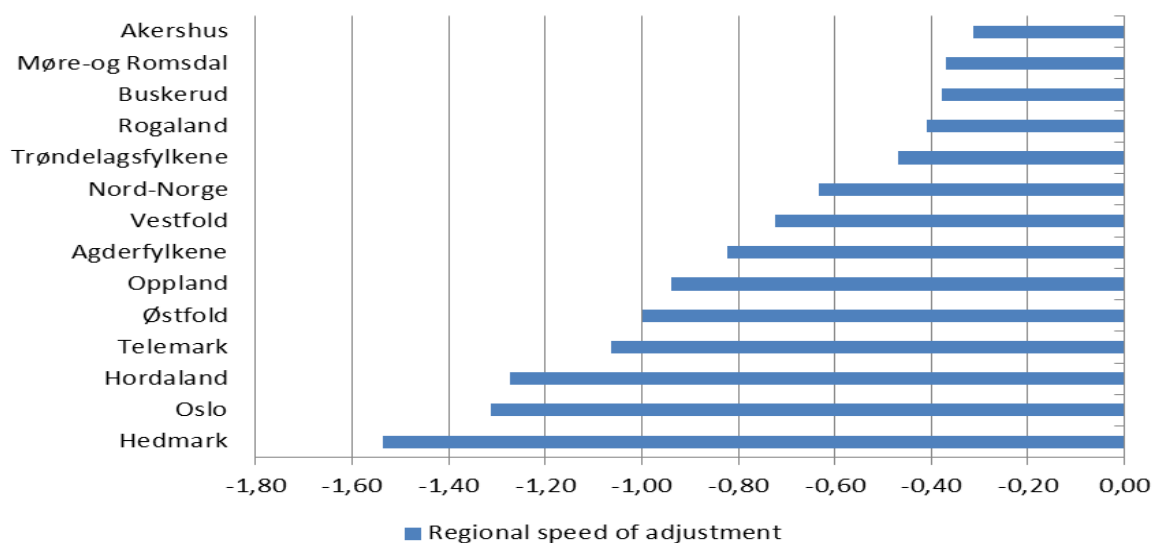


Figure 18: Regional speed of adjustment, actual foreclosures



8 Conclusion

In this thesis I have examined what factors may have contributed to the recent rise in filed and actual foreclosures in Norway. My econometric results suggest that the main explanation behind the rapid increase in filed foreclosures is the growth in household debt. In fact, the rise in the household debt-to-income ratio can account for as much as 50 percent of the increase in filed foreclosures. Consequently, the growth in filed foreclosures may be seen as a sign of increasing the debt vulnerability among Norwegian households. This interpretation, I argue, is supported by lessons from the Norwegian Banking Crisis of the early 1990s, as well as recent developments in other countries. Moreover, I have documented that the increase in filed foreclosures has coincided with an increase in recurring payment problems among Norwegian households and registered execution procedures.

Thus far, the increase in filed foreclosures has not been followed by an equal increase in actual foreclosures. My results suggest that one explanation of this lies in the substantial growth in housing prices over the last decades. Based on the theoretical model developed in this thesis, it is seen that an increase in housing prices increases the debtor's collateral value which has a positive effect on households' possibility (and ability) to refinance their debt. The conjecture is supported by my econometric results. A one percent increase in housing prices is found to lower the number of actual foreclosures by between 1.7 and 2.5 percent in the long run. Consequently, it is reasonable to expect that a much larger fraction of the foreclosure filings would have been realized as actual foreclosures had the development in the housing market been less favorable. Thus, a fall in housing prices is likely to be followed by an increase in the number of actual foreclosures, which may have severe consequences for the banking sector.

As shown in Lindquist (2011), there is a clear connection between households' debt-vulnerability and credit risk, which again is important for the stability of the financial system. However, the direct effect on banks' balance sheets from an increase in filed foreclosures is likely to be modest. Historically, only a small share of the foreclosure filings has been realized as actual foreclosures. Furthermore, banks' losses from the household sector have traditionally been low (Steigum 2004). That said, the increase in filed foreclosure could be interpreted as a signal of an increased risk in the financial system. The increase in filed foreclosures suggests that an increasing number of households' already

are struggling to meet their debt installments, despite the favorable macro-economic conditions. Lindquist (2011) argues that households tend to give priority to fulfilling their debt contract, even if this means a serious cut in private consumption. However, a cut in consumption affects firms' earnings, and could cause default on firms' bank loans. If the increase in filed foreclosures reflects an increase in households' debt vulnerability, a small increase in interest rates or the unemployment rate could potentially have severe implications, as more households would cut their consumption in order to hold on to their house.

Even though my results are indicative of an increased vulnerability among Norwegian households, more research is needed to establish a clear link between households' debt-vulnerability and the foreclosure statistics. The group that experience a foreclosure is diverse, which means that several mechanisms need to be considered in order to explain the developments. In particular, it is possible that a non-negligible share of the actual foreclosures is caused by firms' bankruptcies, since many entrepreneurs use their house as collateral for business loans. (See discussion in appendix B) Moreover, any systematic regional differences in foreclosures could be exploited in order to enhance our knowledge. Finally, it would be interesting to examine the consumption behavior of the receivers of foreclosures filings. To what extent are these households forced to cut back on their consumption? Does history reveal any connection between foreclosure filings and bank losses? Perhaps these queries could shed more light on the broader question regarding the impact of households' debt-vulnerability on financial fragility.

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Appendix

A: The new dataset

Actual foreclosures:

The Norwegian court administration registers the filed foreclosures within a year for each court. If the court decides to foreclose the house, the property is registered in the GAB register (Grunnboksregisteret), which is then sent to Statistic Norway.³⁸ I have gathered the data on foreclosures for each court administration from the period 1980-1993. The data has been aggregated to a county level, where the number of foreclosures for each court administration belonging to the same county is added. The statistics from the court administration is merged with regional data from the GAB-register (1995-2011) so that the numbers of foreclosures is available from 1980 – 2011. The years 1993 and 1994 are missing in this series. The data in these years are misleading since the new law on foreclosures changed the way the court administration registered the foreclosures.

As already pointed out, it is worth noting that the number of actual foreclosures may be substantially downward biased. A large fraction of households are forced to sell their houses due to permanent income setbacks and subsequent failure to pay their mortgage installments. However, households may choose to sell themselves rather than having the court foreclose their house, and will thus not appear in the statistics.

Filed foreclosures:

The number of filed foreclosures are gathered for each court administration and aggregated to the county level for the years 1980 – 2011. For the data on filed foreclosures, the years 2004 and 2005 are missing due to a reorganization of the data collection in the court administration. Note that the number of filed foreclosures includes statistics for housing cooperatives. Statistics Norways' data on filed foreclosures do not contain housing cooperatives and are consequently lower over the sample. Astrup and Holm (2009) argues that the numbers of filed foreclosures may be upward biased as defaulted tax claims on a property will automatically be filed to the court even though the claims may be small. Unfortunately, it is problematic to assess the size of this bias. Yet, the bias should not affect the change in the number of filed foreclosures.

³⁸After the new law on foreclosures in 1993 the actual foreclosed properties noted in GAB (Registeret for grunneiendommer, adresser og bygninger). Prior to this it was the court administration that registered the actual foreclosures.

Housing prices:

Housing prices for 14 regions have been collected from the Norwegian association of real estate Agents (NEF) and housing prices for the five largest Norwegian cities is taken from Norges-Bank Historical monetary Statistics

Household credit:

From 1981 - 1986 the credit series are taken from the Credit Market Statistics of Statistics Norway for private and public banks. The series is collected as loans to wage earners. From 1986 – 2000 the credit series are taken from the ORBOF database of Statistics Norway. Here, the series are collected as banks and credit companies loans to households, including private non-personal enterprises, personal enterprises and self-employed.³⁹

Household data:

County level data on average personal income, households' average level of debt, households' average interest payments are also collected from Statistics Norway, which uses data on household tax payments to construct these variables.

Other variables:

Finally, total population in each county and unemployment data at the county level is taken from Statistics Norway. Only from 1995 is the working force in each county available, so that the actual unemployment rate can only be used from 1995 and onwards. In addition banks average yearly interest on lending is taken from Statistics Norway.

Dataset:

A full 14 region data set including debt, lending, interest payments, housing prices, unemployment, foreclosures and filed foreclosures is available from 1995-2010. A five region sample 1980 -2010 is available with the variables foreclosures, filed foreclosures, household credit, numbers of unemployed, housing prices and real after tax-interest rate.

³⁹To take account of this break in the series I have created a second series where this is corrected for. A combined measure of private non-personal enterprises, personal enterprises and self-employed, wage earners and state enterprises exist on a regional basis in the statistics from 1981-86. In addition for each year the national distribution of these different sectors is collected. Using this national distribution I have constructed a series where private non-personal enterprises, personal enterprises and self-employed are included. The geographical variation of the distribution of these sectors will not be captured in this estimate. Hence this is an important source of error in the series. However, comparing the two series against each other there seems to be little difference.

B: What characterize those who have their homes foreclosed?

Due to the relatively low numbers of actual foreclosures in Norway, one might argue that it is really a marginal phenomenon and one might question whether the developments in foreclosures is based mostly on the individual characteristics of the borrower. One could for instance argue that a fraction of the population experience payment problems regardless of the macroeconomic situation. Indeed, qualitative surveys have shown that foreclosures in some cases are connected with drug abuse, psychiatric illness and divorce, and the people experiencing a foreclosure are held to have poorer economic management than the rest of the population (Astrup and Holm 2009, p 110).

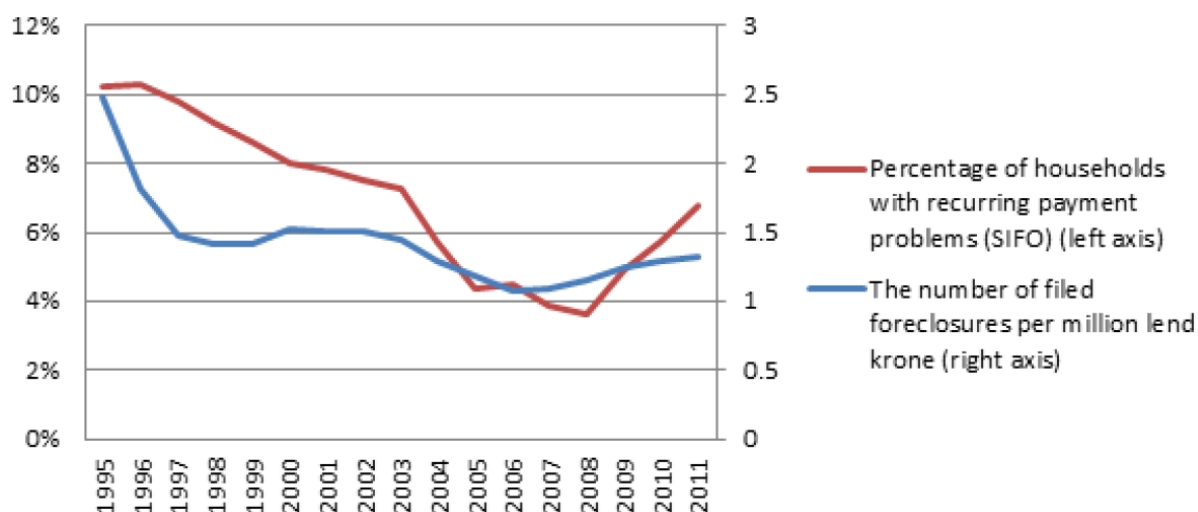
However, this picture does not seem consistent when looking more closely at the evidence. On the contrary, broad macroeconomic variables seem to have a large impact on foreclosures, a point that is also reflected at the individual level. Astrup and Holm (2009) uses a sample of micro-data from the debt-collection company Lindorff to look at the individual characteristics of those who experience a foreclosure. Firstly, these people do not seem to mainly consist of low income groups. In 2008, more than 65 percent of the foreclosures happened to households above the lowest income quintile, and 12 percent of the foreclosures among those of the highest income quintile. Furthermore, these households tend to have a substantially higher debt-to-income ratio than the rest of the population. Almost 50 percent of the households experiencing a foreclosure had a debt level of more than three times their income, and 24 percent had a debt of more than five times their income. The age group 25 – 35 is overrepresented in the sample. This group tends to have less housing equity and is more prone to divorce than the rest of the population (Astrup and Holm 2009, p 120)

Secondly, there seems to be a close connection between filed foreclosures in Norway and households' ability to pay their bills. Figure 19 plots filed foreclosures as a share of total lending on the right axis, and SIFOs measure of recurrent payment problems on the left axis.⁴⁰ We see that these two variables reveal the same trend the last six years, which indicates that the increase in filed foreclosure reflects reduced ability to pay among households.

About half of the individuals who experienced a foreclosure in 2007 and 2008 had commercial interest according to data from Lindorff (Astrup and Holm 2009, p 121).

⁴⁰SIFO - Statens institutt for forbruksforskning

Figure 19: Filed foreclosures and the share of households with recurring payment problems



Recurrent payment problems measures the share of households stating that they have sometimes or often been unable to pay their bills, interest payments or mortgage installments the last year. See Poppe(2011)

This suggests that firm's bankruptcies may affect the number of foreclosures, since some individuals use their house as collateral for commercial loans. Thus, the conditions in the Norwegian business segment are likely to affect the number of foreclosures. That said, Lindorff defines commercial interest broadly including both current and previous owners of ANS (Ansvarlig Selskap) ⁴¹ and AS(Aksjeselskap) in addition to individuals that are or have been members of the board of a company (Astrup and Holm 2009). Only for the current and possible previous owners of ANS are in danger of having their property foreclosed, should they fail to meet their debt installments. Thus, even though many individuals who experience foreclosures have commercial interest, the commercial interests may not be the reason for the foreclosure. However, the mechanism between firms bankruptcies and foreclosure suggest that the number of actual foreclosures is not a problem limited to the household sector alone. The impact from bankruptcies are not considered in this thesis. However I argue that this as an important point of further research.

⁴¹A "Ansvarlig Selskap" is an association in which two or more owners (participants) together or separately have unlimited personal liability for the business debt

C: The bank's decision to grant the mortgage

A vast number of empirical and theoretical papers on the housing market shows how the borrowers collateral value affects the creditors willingness to grant a loan.⁴² In order to show that the model presented is consistent with these findings, we can look at the bank's decision to grant a mortgage in the first place.

For simplicity, assume that the bank faces a constant funding cost $c = 1$ on each krone lend on the mortgage M_0 . Furthermore we consider a case where the household always chooses to stay and uphold the contract.

With probability λ , the high income is realized and the bank receives the profit $\Pi_b^C = M_0(1+r) - cM_0 = rM_0$. With probability $(1-\lambda)$, the bank chooses to foreclose or refinance. Suppose that the bank denotes a probability p_E for the case of refinance from which it receives $V_b^R = \min[E_0(P_2) - M_0, \widehat{M}_0 - M_0]$. Consequently, the banks denote a probability $(1 - p_E)$ for the case of foreclosure, where it receives $\Pi_b^F = \min[E_0(P_1) - c, M_0 - c] = \min[E_0(P_1) - M_0, M_0 - M_0]$ in profits. With these assumptions, the expected value of the mortgage can be written as:

$$E_0(\Pi) = \lambda r M_0 + (1 - \lambda)(p_E * \min[E_0(P_2) - M_0, \bar{r} M_0] + (1 - p_E) \min[E_0(P_1) - M_0, 0]) \quad (39)$$

This profit function has a global maximum at: (see proof next page)

$$\begin{aligned} \frac{M_0}{1+\bar{r}} &= E_0(P_2) \\ \text{for } 1 - p_e(1 + \bar{r}) &< r < \frac{1-\lambda}{\lambda} \end{aligned}$$

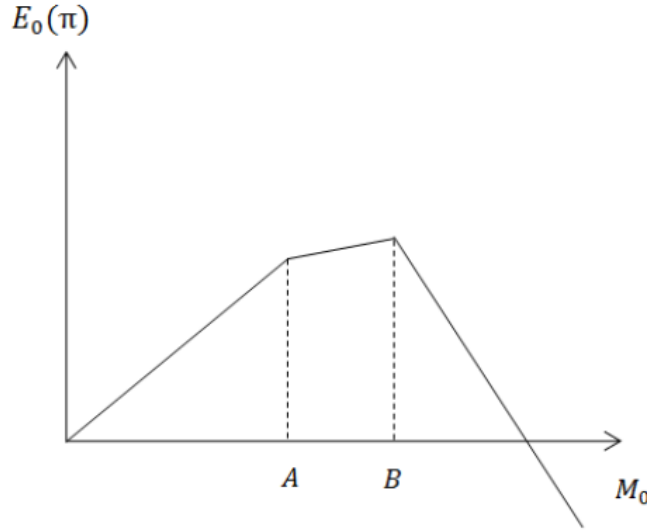
This global maximum clearly depends positively on the expected housing price $E_0(P)$. Consequently, a profit maximizing bank will never grant a mortgage M_0 when the discounted value of the mortgage exceeds the expected period housing value in period two, i.e. $\frac{M_0}{1+\bar{r}} > E_0(P_2)$. Thus, under these assumptions, the banks willingness to extend a mortgage, depends on the *expected* collateral value of the borrower.⁴³

Since the value of M_0 that maximizes the expected profit function depends on expected housing prices, it follows from the presented model that a household's possibility to

⁴²See for instance Bernanke and Getler (1989), Kyataki and Moore (2000) and Borgersen and Sommersvoll (2010) for theoretical contributions. For an empirical investigation of Norwegian data see Anundsen and Jansen(2011), and for other countries see for instance Fitzpatrick and McQuinn (2004) and Oikarinen (2009)

⁴³In order for $\frac{1-\lambda}{\lambda} > (1 - p_e(1 + \bar{r}))$, I assume that $1 > [1 - p_e(1 + \bar{r})]\lambda$ which appears reasonable as λ and p_e are probabilities which consequently cannot exceed one and \bar{r} is a small number

Figure 20: Expected profit function



Where $A : M_0 = E_0(P_1)$ and $B : M_0 = \frac{M_0}{1+\bar{r}} = E_0(P_2)$ for $r < \frac{1-\lambda}{\lambda}$ and $E_0(P_2) > E_0(P_1)$

borrow is constrained by the collateral value. Hence, when housing prices increases, households' will be able to increase their borrowing. These conjectures is consistent with both empirical and theoretical work on the housing market.

This global maximum clearly depends positively on the expected housing price $E_0(P)$. The profit function is drawn in Figure 20 for $1 - p_e(1 + \bar{r}) < r < \frac{1-\lambda}{\lambda}$. The point A is where the mortgage equals the expected housing price in period $t = 1$, $E_0(P_1) = M_0$, and point B is where the discounted mortgage equals the expected housing price in period $t = 2$. i.e. $\frac{M_0}{1+\bar{r}} = E_0(P_2)$.

Proof

For simplicity, assume that $E_0(P_2) = E_0(P_1) = E_0(P)$. To find the banks expected profit maximum, I take the derivative of $E_0(\Pi)$ with respect to M_0 and find the point in which the derivative of the function goes from positive to negative. The function $E_0(\Pi)$ has two "kinks" where it fails to be differentiable since the tangent slopes do not approach the same value from the left as they do from the right. The first "kink" is where $E_0(P) - M_0 = 0 \Leftrightarrow M_0 = E_0(P)$ at the value of M_0 where the second min-function in $E_0(\Pi)$ shifts from 0 to $E_0(P) - M_0$. The second "kink" is where $E_0(P) - M_0 = \bar{r}M_0 \Leftrightarrow \frac{M_0}{1+\bar{r}} = E_0(P)$ at the value of M_0 where the first min-function in $E_0(\Pi)$ shifts from $\bar{r}M_0$ to $E_0(P) - M_0$. Thus, in order to find the derivative of the function $E_0(\Pi)$, three cases needs to be considered. First when $M_0 < E_0(P)$, second, when $E_0(P) < M_0 < E_0(1 + \bar{r})$

and third when $E_0(1 + \bar{r}) < M_0$.

1. $\frac{\delta E_0(\Pi)}{\delta M_0} = \lambda r + (1 - \lambda)p_e \bar{r} > 0$ for $r > \bar{r} > 0$, since the probabilities λ and $p_e > 0$.
2. $\frac{\delta E_0(\Pi)}{\delta M_0} = \lambda r + (1 - \lambda)[p_e \bar{r} - (1 - p_e)] > 0$ for $r > [1 - p_e(1 + \bar{r})](1 - \lambda)$
3. $\frac{\delta E_0(\Pi)}{\delta M_0} = \lambda r - (1 - \lambda) < 0$ for $r < \frac{1 - \lambda}{\lambda}$

Thus there exist a global maximum for the function $E_0(\Pi)$ at the point $\frac{M_0}{1 + \bar{r}} = E_0(P)$ for $1 - p_e(1 + \bar{r}) < r < \frac{1 - \lambda}{\lambda}$.⁴⁴

⁴⁴The assumption that $r < \frac{1 - \lambda}{\lambda}$ seems reasonable as competition in the banking sector may limit the interest the bank may charge.